- 1 Drews J. Drug discovery: a historical perspective. *Science (New York, NY)*. 2000;**287**(5460):1960–4.
- **2** Lichtenberg FR. Pharmaceutical innovation and longevity growth in 30 developing and high-income countries, 2000–2009. National Bureau of Economic Research Working Paper Series. 2012;No. 18235.
- **3** Rottenkolber D, Schmiedl S, Rottenkolber M, Farker K, Salje K, Mueller S, et al. Adverse drug reactions in Germany: direct costs of internal medicine hospitalizations. *Pharmacoepidemiology and Drug Safety*. 2011;**20**(6):626–34.
- **4** Gray A. Adverse events and the National Health Service: an economic perspective. University of Oxford; 2003.
- **5** Fu AZ, Jiang JZ, Reeves JH, Fincham JE, Liu GG, Perri M 3rd. Potentially inappropriate medication use and healthcare expenditures in the US community-dwelling elderly. *Medical Care*. 2007;**45**(5):472–6.
- 6 Sellers JA. Medicare drug benefit. *American Journal of Health-System Pharmacy*. 1999;**56**(15):1503.
- **7** Le Grand A, Hogerzeil HV, Haaijer-Ruskamp FM. Intervention research in rational use of drugs: a review. *Health Policy and Planning*. 1999;**14**(2):89–102.
- **8** OECD, Health at a Glance 2011: OECD Indicators. Pharmaceutical expenditure. Available at: http://www.oecd.org/els/health-systems/49105858.pdf (last accessed 18 Novembr 2015)
- **9** Lee TH, Emanuel EJ. Tier 4 drugs and the fraying of the social compact. *New England Journal of Medicine*. 2008;**359**(4):333–5.
- **10** Thorpe KE. The rise in health care spending and what to do about it. *Health Affairs* 2005;**24**(6): 1436–45.

- 11 Zuvekas SH, Cohen JW. Prescription drugs and the changing concentration of health care expenditures. *Health Affairs (Project Hope)*. 2007;**26**(1):249–57.
- 12 Malmstrom RE, Godman BB, Diogene E, Baumgartel C, Bennie M, Bishop I, et al. Dabigatran a case history demonstrating the need for comprehensive approaches to optimize the use of new drugs. *Frontiers in Pharmacology.* 2013;**4**:39.
- 13 Godman B, Wettermark B, van Woerkom M, Fraeyman J, Alvarez-Madrazo S, Berg C, et al. Multiple policies to enhance prescribing efficiency for established medicines in Europe with a particular focus on demand-side measures: findings and future implications. *Frontiers in Pharmacology*. 2014;5:106.
- **14** Cameron A, Ewen M, Ross-Degnan D, Ball D, Laing R. Medicine prices, availability, and affordability in 36 developing and middle-income countries: a secondary analysis. *Lancet*. 2009;**373**(9659):240–9.
- **15** Gumbs PD, Verschuren WM, Souverein PC, Mantel-Teeuwisse AK, de Wit GA, de Boer A, et al. Society already achieves economic benefits from generic substitution but fails to do the same for therapeutic substitution. *British Journal of Clinical Pharmacology.* **2007**;**64**(5):680–5.
- **16** Lubloy A. Factors affecting the uptake of new medicines: a systematic literature review. *BMC Health Services Research*. 2014;**14**:469.
- 17 Dukes MNG, ed. *Drug Utilization Studies: Methods and Uses*. Copenhagen, WHO Regional Office for Europe, 1993. WHO Regional Publications European Series No. 45.
- **18** Engel A, Siderius P. *The Consumption of Drugs. Report on a Study, 1966–1967.* Copenhagen, WHO Regional Office for Europe, 1968. EURO 3101.
- **19** World Health Organization. *Consumption of Drugs: Report on a Symposium.* Copenhagen, WHO regional Office for Europe, 1970. EURO 3102.

- 20 Bergman U, Elmes P, Halse M, Halvorsen T, Hood H, Lunde PK, et al. The measurement of drug consumption. Drugs for diabetes in Northern Ireland, Norway and Sweden. European Journal Of Clinical Pharmacology. 1975;8(2):83–89.
- 21 Bergman U, Grimsson A, Wahba AHW, Westerholm B. Studies in Drug Utilization. Methods and Applications. Copenhagen, WHO Regional Publications, 1979. European Series No 8.
- 22 Stolley PD, Lasagna L. Prescribing patterns of physicians. *Journal of Chronic Diseases*. 1969;22(6):395–405.
- **23** Hemminki E. Review of literature on the factors affecting drug prescribing. *Social Science & Medicine*. 1975;**9**(2):111–16.
- 24 Mapes R. Aspects of British general practitioners' prescribing. *Medical Care*. 1977;15(5):371–81.
- **25** Bergman U. The history of the Drug Utilization Research Group in Europe. *Pharmacoepidemiology and Drug Safety.* **2006;15**(2):95–8.
- **26** Schubert I. The founding of the EURO-DURG, the European Drug Utilization Research Group. *International Journal of Clinical Pharmacology and Therapeutics*. 1996;**34**(9):410–13.
- 27 1st Meeting of EURO DURG, the European Drug Utilization Research Group. Hungary, 27–30 June 1996. Abstracts. *European Journal of Clinical Pharmacology*. 1997;**52**(3):A19–28.
- **28** Baksaas I, Lunde PKM. National drug policies: the need for drug utilization studies. *Trends in Pharmacological Sciences*. 1986;**7**(4):331–4.
- 29 Crooks J. Methods of audit in drug use. In: Duchene-Marulla ZP, ed. Advances in Pharmacology and Therapeutics. Proceedings of 7th International Congress of Pharmacology, Paris, 1978. Oxford, Pergamon Press, 1979: 189–95.
- 30 Sjöqvist F, Agenäs I. Drug utilization studies: implications for medical care. Proceedings from ANIS Symposium, Sånga-Säby, Sweden. Acta Medica Scandinavica. 1983;105 (Suppl. 683).
- **31** Laporte JR, Porta M, Capella D. Drug utilization studies: a tool for determining the effectiveness of drug use. *British Journal of Clinical Pharmacology*. 1983;**16**(3):301–4.
- **32** Lunde PK, Baksaas I. Epidemiology of drug utilization--basic concepts and methodology. *Acta Medica Scandinavica Supplementum*. 1988;**721**:7–11.
- **33** World Health Organization. *How to Investigate Drug Use in Health Facilities: Selected Drug Use Indicators.*

- World Health Organization, 1993. EDM Research Series No. 007.
- **34** McGavock H. *Handbook of Drug Use Research Methodology.* Newcastle upon Tyne, United Kingdom Drug Utilisation Research Group, 2000.
- **35** Lee D, Bergman U. Studies of drug utilization. In: Strom BL, Kimmel SE, Hennessy S, eds. *Pharmacoepidemiology*. Chichester, John Wiley & Sons, 2011.
- 36 World Health Organization. Introduction to Drug Utilization Research. Oslo, World Health Organization, 2003.
- 37 Wettermark B, Vlahovic-Palcevski V, Salvesen Blix H, Ronning M, Vander Stichele RH. Drug utilization research. In: Hartzema AG, Tilson HH, Chan KA, eds. *Pharmacoepidemiology and Therapeutic Risk Management*. Cincinnati, OH, Harvey Whitney Books, 2008.
- **38** Hoven JL, Haaijer-Ruskamp FM, Vander Stichele RH. Indicators of prescribing quality in drug utilisation research: report of a European meeting (DUR-QUIM, 13–15 May 2004). *European Journal of Clinical Pharmacology.* 2005;**60**(11):831–4.
- **39** Kubacka RT. A primer on drug utilization review. *Journal of the American Pharmaceutical Association*. 1996;**NS36**(4):257–61,279.
- **40** Serradell J, Bjornson DC, Hartzema AG. Drug utilization study methodologies: national and international perspectives. *Drug Intelligence & Clinical Pharmacy.* 1987;**21**(12):994–1001.
- **41** Blackburn JL. Impact of drug usage review on drug utilisation. *Pharmacoeconomics*. 1993;**3**(1):14–21.
- **42** Sigell LT, Nelson DE, Yokel RA, Lorenzi N. Past, present and future of drug information centers as catalysts for the utilization of drug therapy information. *Drug Information Journal*. 1977;**11**(1):11–16.
- **43** Woosley RL. Centers for education and research in therapeutics. *Clinical Pharmacology and Therapeutics*. 1994;**55**(3):249–55.
- **44** Tilson HH, Madre LK, Califf RM. Role of the Centers for Education and Research on Therapeutics (CERTs) in pharmacovigilance and proper use of therapeutics. *Clinical Pharmacology & Therapeutics*. 2007;**82**(2):118–21.
- **45** Buschiazzo H, Vhaves A, Figueras A, Laporte JR. Drug utilization in Latin America the example of DURG-LA. *WHO Essential Drugs Monitor.* 2003;**032**.
- 46 Hall RC. Drug use in Australia. In: Sjöqvist F, Agenäs I, eds. Drug utilization studies: implications for medical care. *Acta Medica Scandinavica*. 1983;Suppl. 30:79–80.

- **47** Hogerzeil HV. Trends in drug utilization research in developing countries. *WHO Drug Information*. 2002;**16**.
- **48** World Health Organization. The selection of essential drugs. Report of a WHO Expert Committee. 1977.
- **49** Strom BL, Kimmel SE, Hennessy S. *Pharmacoepide-miology*. Chichester, John Wiley & Sons, 2011.
- **50** Bergman U. Pharmacoepidemiology from description to quality assessment: a Swedish perspective. *Norsk epidemiologi.* 2001;**11**(1).
- 51 Gorecka K, Hejdova M, Vander Stichele RH, Linhartova A, Kucera Z, Zemkova M, et al. Abstracts on drug utilization research at seven International Conferences on Pharmacoepidemiology (ICPE): 1996–2002. *Pharmacoepidemiology and Drug Safety*. 2004;13(9):621–2.
- 52 Institute of Medicine, Committee on Health Services Research: Training and Work Force Issues. Health Services Research: Workforce and Educational Issues. Washington, DC, National Academy Press, 1995.
- 53 Birkett D, Brosen K, Cascorbi I, Gustafsson LL, Maxwell S, Rago L, et al. Clinical pharmacology in research, teaching and health care: considerations by IUPHAR, the International Union of Basic and

- Clinical Pharmacology. *Basic & Clinical Pharmacology & Toxicology*. 2010;**107**(1):531–59.
- **54** American College of Clinical Pharmacy. The definition of clinical pharmacy. *Pharmacotherapy*. 2008;**28**(6):816–17.
- 55 Henshall C, Oortwijn W, Stevens A, Granados A, Banta D. Priority setting for health technology assessment. Theoretical considerations and practical approaches. Priority setting Subgroup of the EUR-ASSESS Project. *International Journal of Tech*nology Assessment in Health Care. 1997;13(2):144–85.
- **56** Clancy CM, Eisenberg JM. Outcomes research: measuring the end results of health care. *Science* (*New York, NY*). 1998;**282**(5387):245–6.
- 57 Bootman JL, Townsend RJ, McGhan WF. Principles of Pharmacoeconomics. Cincinnati, OH, Harvey Whitney Books Company, 2005.
- **58** World Health Organization. *The Importance of Pharmacovigilance*. World Health Organization, 2002.
- 59 Hirst C, Cook S, Dai W, Perez-Gutthann S, Andrews E. A call for international harmonization in therapeutic risk management. *Pharmacoepidemiology and Drug Safety*. 2006;15(12):839–49; disc. 50–1.
- **60** Seiter A. *A Practical Approach to Pharmaceutical Policy*. World Bank Publications, 2010.

- 1 Pope C, Mays N. Reaching the parts other methods cannot reach: an introduction to qualitative methods in health and health services research. *British Medical Journal (Clinical Research Edition)*. 1995;**311**:42–5.
- **2** Grimes DA, Schulz KF. Descriptive studies: what they can and cannot do. *Lancet*. 2002;**359**:145–9.
- **3** Wettermark B, Nyman K, Bergman U. Five years' experience of quality assurance and feedback with individual prescribing profiles at a primary health-care centre in Stockholm, Sweden. *Quality in Primary Care*. 2004;**12**:225–34.
- **4** Sermet C, Andrieu V, Godman B, Van Ganse E, Haycox A, Reynier JP. Ongoing pharmaceutical reforms in France: implications for key stakeholder groups. *Applied Health Economics and Health Policy*. 2010;**8**:7–24.
- 5 Garuoliene K, Godman B, Gulbinovic J, Wettermark B, Haycox A. European countries with small populations can obtain low prices for drugs: Lithuania as a case history. *Expert Review of Pharmacoeconomics & Outcomes Research.* 2011;11:343–9.
- **6** Lupattelli A, Spigset O, Twigg MJ, et al. Medication use in pregnancy: a cross-sectional, multinational web-based study. *British Medical Journal Open*. 2014;**4**:e004365.
- **7** Languasco A, Galante M, Marin J, Soler C, Lopez Saubidet C, Milberg M. Adherence to local guidelines for venous thromboprophylaxis: a cross-sectional study of medical inpatients in Argentina. *Thrombosis Journal* 2011;**9**:18.
- **8** Elseviers MM, Vander Stichele RR, Van Bortel L. Quality of prescribing in Belgian nursing homes: an electronic assessment of the medication chart. *International Journal for Quality in Health Care*. 2014;**26**:93–9.
- **9** Galvao TF, Silva MT, Gross R, Pereira MG. Medication use in adults living in Brasilia, Brazil: a

- cross-sectional, population-based study. *Pharmacoepidemiology and Drug Safety*. 2014;**23**:507–14.
- 10 Dong L, Wang D, Gao J, Yan H. Doctor's injection prescribing and its correlates in village health clinics across 10 provinces of Western China. *Journal of Public Health (Oxford, England)*. 2011;33:565–70.
- 11 Lusini G, Lapi F, Sara B, et al. Antibiotic prescribing in paediatric populations: a comparison between Viareggio, Italy and Funen, Denmark. *European Journal of Public Health*. 2009;19:434–8.
- 12 Loikas D, Wettermark B, von Euler M, Bergman U, Schenck-Gustafsson K. Differences in drug utilisation between men and women: a cross-sectional analysis of all dispensed drugs in Sweden. *British Medical Journal Open.* 2013;3.
- 13 Watkins C, Harvey I, Carthy P, Moore L, Robinson E, Brawn R. Attitudes and behaviour of general practitioners and their prescribing costs: a national cross sectional survey. *Quality & Safety in Health Care*. 2003;12:29–34.
- 14 Melander A, Folino-Gallo P, Walley T, et al. Utilisation of antihyperglycaemic drugs in ten European countries: different developments and different levels. *Diabetologia*. 2006;49:2024–9.
- 15 Hollingworth SA, Rush A, Hall WD, Eadie MJ. Utilization of anti-Parkinson drugs in Australia: 1995–2009. *Pharmacoepidemiology and Drug Safety*. 2011;**20**:450–6.
- **16** Davidsen JR, Sondergaard J, Hallas J, et al. Impact of socioeconomic status on the use of inhaled corticosteroids in young adult asthmatics. *Respiratory Medicine*. 2011;**105**:683–90.
- 17 Boyc KS, Yurgin N, Lage MJ. Trends in the prescription of antidiabetic medications in France: evidence from primary care physicians. *Advances in Therapy*. 2007;24:803–13.
- 18 ZoegaH,BaldurssonG,HrafnkelssonB,AlmarsdottirAB, Valdimarsdottir U, Halldorsson M. Psychotropic drug use among Icelandic children: a nationwide

- population-based study. *Journal of Child and Adolescent Psychopharmacology*. 2009;**19**:757–64.
- 19 Kotwani A, Holloway K. Trends in antibiotic use among outpatients in New Delhi, India. BMC Infectious Diseases. 2011:11:99.
- 20 Mojtabai R, Olfson M. National trends in long-term use of antidepressant medications: results from the US National Health and Nutrition Examination Survey. *The Journal of Clinical Psychiatry*. 2014;75:169–77.
- **21** Leri F, Ayzenberg M, Voyce SJ, Klein A, Hartz L, Smego RA Jr. Four-year trends of inappropriate proton pump inhibitor use after hospital discharge. *Southern Medical Journal*. 2013;**106**:270–3.
- **22** Vitry A, Lai YH. Advertising of antihypertensive medicines and prescription sales in Australia. *Internal Medicine Journal* 2009;**39**:728–32.
- **23** Vozoris NT, Fischer HD, Wang X, et al. Benzodiazepine use among older adults with chronic obstructive pulmonary disease: a population-based cohort study. *Drugs & Aging*. 2013;**30**:183–92.
- **24** Teuner CM, Menn P, Heier M, Holle R, John J, Wolfenstetter SB. Impact of BMI and BMI change on future drug expenditures in adults: results from the MONICA/KORA cohort study. *BMC Health Services Research*. 2013;**13**:424.
- 25 Karlsson L, Wettermark B, Tomson T. Drug treatment in patients with newly diagnosed unprovoked seizures/epilepsy. *Epilepsy Research* 2014;108:902–8.
- **26** Citarella A, Kieler H, Sundstrom A, et al. Family history of cardiovascular disease and influence on statin therapy persistence. *European Journal of Clinical Pharmacology*. 2014;**70**:701–7.
- 27 Sino CG, Stuffken R, Heerdink ER, Schuurmans MJ, Souverein PC, Egberts TA. The association between prescription change frequency, chronic disease score and hospital admissions: a case control study. *BMC Pharmacology & Toxicology*. 2013;14:39.
- **28** Burr NE, Talboys RJ, Savva S, et al. Aspirin may prevent cholangiocarcinoma: a case-control study from the United kingdom. *Digestive Diseases and Sciences*. 2014;**59**:1567–72.
- **29** Willson MN, Greer CL, Weeks DL. Medication regimen complexity and hospital readmission for an adverse drug event. *The Annals of Pharmacotherapy*. 2014;**48**:26–32.
- **30** Breekveldt-Postma NS, Erkens JA, Aalbers R, van de Ven MJ, Lammers JW and Herings RM. Extent of uncontrolled disease and associated medical costs in

- severe asthma a PHARMO study. Current Medical Research and Opinion. 2008;24:975–83.
- **31** van der Hooft CS, Schoofs MW, Ziere G, et al. Inappropriate benzodiazepine use in older adults and the risk of fracture. *British Journal of Clinical Pharmacology*. 2008;**66**:276–82.
- **32** Juurlink DN, Mamdani M, Kopp A, Laupacis A, Redelmeier DA. Drug-drug interactions among elderly patients hospitalized for drug toxicity. *Journal of the American Medical Association*. 2003;**289**:1652–8.
- **33** Grimshaw J, Campbell M, Eccles M, Steen N. Experimental and quasi-experimental designs for evaluating guideline implementation strategies. *Family Practice* 2000;**17**(Suppl. 1):S11–16.
- 34 Stephenson J, Imrie J. Why do we need randomised controlled trials to assess behavioural interventions? British Medical Journal (Clinical Research Edition). 1998;316:611–13.
- **35** O'Connell DL, Henry D, Tomlins R. Randomised controlled trial of effect of feedback on general practitioners' prescribing in Australia. *British Medical Journal (Clinical Research Edition)*.1999;**318**:507–11.
- 36 Lu CY, Ross-Degnan D, Stephens P, Liu B, Wagner AK. Changes in use of antidiabetic medications following price regulations in China (1999–2009). *Journal of Pharmaceutical Health Services Research*. 2013;4:3–11.
- 37 Sondergaard J, Foged A, Kragstrup J, et al. Intensive community pharmacy intervention had little impact on triptan consumption: a randomized controlled trial. *Scandinavian Journal of Primary Health Care*. 2006:24:16–21.
- **38** Martikainen JE, Saastamoinen LK, Korhonen MJ, Enlund H, Helin-Salmivaara A. Impact of restricted reimbursement on the use of statins in Finland: a register-based study. *Medical Care*. 2010;**48**:761–6.
- **39** van Doormaal JE, van den Bemt PM, Zaal RJ, et al. The influence that electronic prescribing has on medication errors and preventable adverse drug events: an interrupted time-series study. *Journal of the American Medical Informatics Association*. 2009;**16**:816–25.
- **40** "Pettersson E, Vernby Å, Mölstad S, Stålsby Lundborg C. Can a multifaceted intervention targeting both nurses and physicians change the prescribing of antibiotics to nursing home residents? A cluster randomized controlled trial. Journal of Antimicrobial Chemotherapy. 2011;66(11):2659–66." Renumber all subsequent references accordingly.

- **41** Lambert MF, Masters GA, Brent SL. Can mass media campaigns change antimicrobial prescribing? A regional evaluation study. *Journal of Antimicrobial Chemotherapy*. 2007;**59**:537–43.
- **42** Dormuth CR, Carney G, Taylor S, Bassett K, Maclure M. A randomized trial assessing the impact of a personal printed feedback portrait on statin prescribing in primary care. *Journal of Continuing Education in the Health Professions*. 2012;**32**:153–62.
- **43** Lipsey MW, Wilson DB. The efficacy of psychological, educational, and behavioral treatment. Confirmation from meta-analysis. *The American Psychologist*. 1993;**48**:1181–209.
- **44** Cochrane Effective Practice and Organisation of Care Review Group. Data collection checklist. Available from: http://epoc.cochrane.org/sites/epoc.cochrane.org/files/uploads/datacollectionchecklist. pdf (last accessed 18 November 2015).
- **45** Grimshaw JM, Thomas RE, MacLennan G, et al. Effectiveness and efficiency of guideline dissemination and implementation strategies. *Health Technology Assessment (Winchester, England)*. 2004;**8**:iii–iv,1–72.
- **46** Wagner AK, Soumerai SB, Zhang F, Ross-Degnan D. Segmented regression analysis of interrupted time series studies in medication use research. *Journal of Clinical Pharmacy and Therapeutics*. 2002;**27**:299–309.
- **47** Morgenstern H. Ecologic studies in epidemiology: concepts, principles, and methods. *Annual Review of Public Health*. 1995;**16**:61–81.
- **48** Bronzwaer SL, Cars O, Buchholz U, et al. A European study on the relationship between antimicrobial use and antimicrobial resistance. *Emerging Infectious Diseases*. 2002;**8**:278–82.
- **49** Carlsten A, Waern M, Ekedahl A, Ranstam J. Antidepressant medication and suicide in Sweden. *Pharmacoepidemiol Drug Safety*. 2001;**10**(6):525–30.
- 50 Gusmao R, Quintao S, McDaid D, et al. Antidepressant utilization and suicide in Europe: An ecological multi-national study. *PloS ONE*. 2013;8:e66455.
- 51 Kwong JC, Maaten S, Upshur RE, Patrick DM, Marra F. The effect of universal influenza immunization on antibiotic prescriptions: an ecological study. *Clinical Infectious Diseases: An Official Publication of the Infec*tious Diseases Society of America. 2009;49:750–6.
- **52** Xu Y, Bentley RJ, Kavanagh AM. Gender equity and contraceptive use in China: an ecological analysis. *Women & Health*. 2011;**51**:739–58.

- 53 Vancheri F, Wettermark B, Strender LE, Backlund LG. Trends in coronary heart disease mortality and statin utilization in two European areas with different population risk levels: Stockholm and Sicily. *International Cardiovascular Forum Journal*. 2014;3:140–6.
- **54** Lee YK, Ha YC, Park C, Yoo JJ, Shin CS, Koo KH. Bisphosphonate use and increased incidence of subtrochanteric fracture in South Korea: results from the National Claim Registry. *Osteoporosis International*. 2013;**24**:707–11.
- 55 Sofianopoulou E, Rushton SP, Diggle PJ, Pless-Mulloli T. Association between respiratory prescribing, air pollution and deprivation, in primary health care. *Journal of Public Health (Oxford, England)*. 2013;35:502–9.
- Martin RM, Wheeler BW, Metcalfe C, Gunnell D. What was the immediate impact on population health of the recent fall in hormone replacement therapy prescribing in England? Ecological study. *Journal of Public Health (Oxford, England)*. 2010;32:555–64.
- 57 Kozman D, Graziul C, Gibbons R, Alexander GC. Association between unemployment rates and prescription drug utilization in the United States, 2007–2010. BMC Health Services Research. 2012;12:435.
- **58** Rikala M, Hartikainen S, Sulkava R, Korhonen MJ. Validity of the Finnish Prescription Register for measuring psychotropic drug exposures among elderly finns: a population-based intervention study. *Drugs & Aging*. 2010;**27**:337–49.
- 59 Dahlen E, Almqvist C, Bergstrom A, Wettermark B, Kull I. Factors associated with concordance between parental-reported use and dispensed asthma drugs in adolescents: findings from the BAMSE birth cohort. *Pharmacoepidemiology and Drug Safety*. 2014;23:942–9.
- **60** Capella D, Pedros C, Vidal X, Laporte JR. Case-population studies in pharmacoepidemiology. *Drug Safety*. 2002;**25**:7–19.
- **61** Theophile H, Laporte JR, Moore N, Martin KL, Begaud B. The case-population study design: an analysis of its application in pharmacovigilance. *Drug Safety*. 2011;**34**:861–8.
- **62** Roujeau JC, Guillaume JC, Fabre JP, Penso D, Flechet ML, Girre JP. Toxic epidermal necrolysis (Lyell syndrome). Incidence and drug etiology in France, 1981–1985. *Archives of Dermatology*. 1990;**126**:37–42.

- 63 Roujeau JC, Kelly JP, Naldi L, et al. Medication use and the risk of Stevens-Johnson syndrome or toxic epidermal necrolysis. New England Journal of Medicine. 1995;333:1600-7.
- 64 Mockenhaupt M, Viboud C, Dunant A, et al. Stevens-Johnson syndrome and toxic epidermal necrolysis: assessment of medication risks with emphasis on recently marketed drugs. The EuroSCAR-study. Journal of Investigative Dermatology. 2008;128:35-44.
- 65 Hallas J. Evidence of depression provoked by cardiovascular medication: a prescription sequence symmetry analysis. Epidemiology (Cambridge, MA). 1996:7:478-84.
- 66 Hersom K, Neary MP, Levaux HP, Klaskala W, Strauss JS. Isotretinoin and antidepressant pharmacotherapy: a prescription sequence symmetry analysis. Journal of the American Academy of Dermatology. 2003;49:424-32.
- 67 Garrison SR, Dormuth CR, Morrow RL, Carney GA, Khan KM. Nocturnal leg cramps and prescription use that precedes them: a sequence symmetry analysis. Archives of Internal Medicine. 2012;172:120-6.
- 68 Lai EC, Hsieh CY, Kao Yang YH, Lin SJ. Detecting potential adverse reactions of sulpiride in schizo-

- phrenic patients by prescription sequence symmetry analysis. PloS ONE. 2014;9:e89795.
- 69 von Elm E, Altman DG, Egger M, Pocock SJ, Gotzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. Lancet. 2007;370:1453-7.
- 70 Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. International Journal for Quality in Health Care. 2007;**19**:349-57.
- 71 Langan SM, Benchimol EI, Guttmann A, et al. Setting the RECORD straight: developing a guideline for the REporting of studies Conducted using Observational Routinely collected Data. Clinical epidemiology. 2013;5:29-31.
- 72 European Network of Centres for Pharmacoepidemiology and Pharmacovigilance. ENCePP Guide on Methodological Standards in Pharmacoepidemiology. ENCePP, 2014.
- 73 Epstein M. Guidelines for good pharmacoepidemiology practices (GPP). Pharmacoepidemiology and Drug Safety. 2005;14:589-95.

- 1 Wettermark B. The intriguing future of pharma-coepidemiology. *European Journal of Clinical Pharmacology*. 2013;**69**(Suppl. 1):43–51.
- **2** Persaud N. Primary data source. In: Salkind NJ, ed. *Encyclopedia of Research Design*. SAGE Publications, 2010: 1095–8.
- 3 Kothari C, Garg G. *Research Methodology: Methods and Techniques*, 3rd edn. New Delhi, New Age Publications, 2014.
- **4** Rothman K, Greenland S, Lash T. *Modern Epidemiology*, 3rd edn. Philadelphia, PA, Lippincott Williams & Wilkins, 2008.
- **5** Kornegay C, Segal J. Selection of data sources In: Velentgas PDN, Nourjah P, et al., eds. *Developing a Protocol for Observational Comparative Effectiveness Research: A User's Guide*. Rockville, MD, Agency for Healthcare Research and Quality, 2013: 109–28. AHRQ Publication 12(13)-EHC099.
- **6** Szklo M, Nieto J. *Epidemiology: Beyond the Basics*, 3rd edn. Sudbury, Jones and Bartlett Publishers, 2012.
- 7 Miettinen OS. *Epidemiological Research: Terms and Concepts.* Dordrecht, Springer, 2011.
- **8** Porta M. *A Dictionary of Epidemiology*, 5th edn. New York, Oxford University Press, 2008.
- **9** Schultze U, Avital M. Designing interviews to generate rich data for information systems research. *Information and Organization*. 2011;**21**(1):1–16.
- 10 Nielsen MW, Sondergaard B, Kjoller M, Hansen EH. Agreement between self-reported data on medicine use and prescription records vary according to method of analysis and therapeutic group. *Journal of Clinical Epidemiology*. 2008;61(9):919–24.
- 11 Van den Brandt PA, Petri H, Dorant E, Goldbohm RA, Van de Crommert S. Comparison of questionnaire information and pharmacy data on

- drug use. *Pharmaceutisch weekblad. Scientific Edition.* 1991;**13**(2):91–6.
- **12** Loo RL, Chan Q, Brown IJ, et al. A comparison of self-reported analgesic use and detection of urinary ibuprofen and acetaminophen metabolites by means of metabonomics: the INTERMAP Study. *Am J Epidemiol.* 2012;**175**(4):348–58.
- 13 Vancheri F, Strender L, Backlund L. General practitioners' coronary risk estimates, decisions to start lipid-lowering treatment, gender and length of clinical experience: their interactions in primary prevention. *Primary Health Care Research & Development*. 2013;14(4):394–402.
- **14** Deepmala D, Franz L, Aponte C, Agrawal M, Jiang W. Identification of provider characteristics influencing prescription of analgesics: a systematic literature review. *Pain Practice*, 2013;**13**(6):504–13.
- 15 Pai R, Ramji A, Lee S, Wong W, Yoshida E. Chronic hepatitis C in Western Canada: a survey of practice patterns among gastroenterologists in Alberta and British Columbia. *Canadian Journal of Gastroenterological Hepatology*. 2014;28(1):e1–4.
- **16** Wolfert M, Gilson A, Dahl J, Cleary J. Opioid analgesics for pain control: Wisconsin physicians' knowledge, beliefs, attitudes, and prescribing practices. *Pain Medicine*. 2010;**11**(3):425–34.
- **17** Thorpe C, Ryan B, McLean S, et al. How to obtain excellent response rates when surveying physicians. *Family Practice*. 2009;**26**(1):65–8.
- **18** Bjertnaes O, Garratt A, Botten G. Nonresponse bias and cost-effectiveness in a Norwegian survey of family physicians. *Evaluation & The Health Professions*. 2008;**31**(1):65–80.
- **19** VanGeest J, Johnson T, Welch V. Methodologies for improving response rates in surveys of physicians: a systematic review. *Evaluation & The Health Professions*. 2007;**30**(4):303–21.

- **20** Bertsche T, Niemann D, Mayer Y, Ingram K, Hoppe-Tichy T, Haefeli W. Prioritising the prevention of medication handling errors. *Pharmacy World & Science*. 2008;**30**(6):907−15.
- **21** Bhanbhro S, Drennan V, Grant R, Harris R. Assessing the contribution of prescribing in primary care by nurses and professionals allied to medicine: a systematic review of literature. *BMC Health Services Research*. 2011;**11**:330.
- **22** Braund R, Coulter C, Bodington A, et al. Drug related problems identified by community pharmacists on hospital discharge prescriptions in New Zealand. *International Journal of Clinical Pharmacy*. 2014;**36**(3):498–502.
- 23 Pedersen C, Schneider P, Scheckelhoff D. ASHP national survey of pharmacy practice in hospital settings: prescribing and transcribing 2013. American Journal of Health Systems Pharmacy. 2014;71(11):924–42.
- **24** Schommer J, Gaither C. A segmentation analysis for pharmacists' and patients' views of pharmacists' roles. *Research in Social & Administrative Pharmacy*. 2014;**10**(3):508–28.
- **25** Hughes C, Hawwa A, Scullin C, et al. Provision of pharmaceutical care by community pharmacists: a comparison across Europe. *Pharmacy World & Science*. 2010;**32**:472–87.
- **26** Worley M, Schommer J, Brown L, et al. Pharmacists' and patients' roles in the pharmacist-patient relationship: are pharmacists and patients reading from the same relationship script? *Research in Social* & Administrative Pharmacy. 2007;**3**(1):47–69.
- 27 Hutchison M, Lindblad A, Guirguis L, Cooney D, Rodway M. Survey of Alberta hospital pharmacists' perspectives on additional prescribing authorization. *American Journal of Health Systems Pharmacy*. 2012;69(22):1983–92.
- **28** Kierkegaard P. E-prescription across Europe. *Health Technology*. 2013;**3**:205–19.
- **29** Olsen J. Register-based research: some methodological considerations. *Scandinavian Journal of Public Health*. 2011;**39**:225–9.
- **30** Chen Y, Briesacher B. Use of instrumental variable in prescription drug research with observational data: a systematic review. *Journal of Clinical Epidemiology*. 2011;**64**(6):687–700.
- **31** Perini E, Junqueira DRG, Lana LGC, Luz TCB. Prescription, dispensation and marketing pat-

- terns of methylphenidate. *Revista de Sa*úde *Pública*. 2014;**48**(6):873–80.
- **32** Desalegn A. Assessment of drug use pattern using WHO prescribing indicators at Hawassa University Teaching and Referral Hospital, south Ethiopia: a cross-sectional study. *BMC Health Services Research*. 2013;**13**(170).
- **33** Chu C, Rudant E, Bonvalet M, et al. Generic drug prescriptions following hospital discharge: a prospective study in France. *European Journal of Internal Medicine*. 2011;**22**:e45–9.
- **34** Siqueira J, Antoniolli A, Silvestre C, et al. Analysis of the quality of prescriptions at a cardiovascular ward in Brazil: a pilot study. *International Journal of Clinical Pharmacy*. 2011;**33**(2):260–3.
- **35** Al Shahaibi N, Al Said L, Kini T, Chitme H. Identifying errors in handwritten outpatient prescriptions in Oman. *Journal of Young Pharmacists*. 2012;**4**(4):267–72.
- **36** Winslow E, Nestor V, Davidoff S, Thompson P, Borum J. Legibility and completeness of physicians' handwritten medication orders. *Heart Lung*. 1997;**26**:158–64.
- **37** Saczynski JS, McManus DD, Goldberg RJ. Commonly used data-collection approaches in clinical research. *American Journal of Medicine*. 2013;**126**(11):946–50.
- **38** Bai J, Mukherjee D, Befus M, Apa Z, Lowy F, Larson E. Concordance between medical records and interview data in correctional facilities. *BMC Medical Research Methodology*. 2014;**9**(14):50.
- 39 World Health Organization. Introduction to Drug Utilization Research. Oslo, WHO International Working Group for Drug Statistics Methodology, WHO Collaborating Centre for Drug Statistics Methodology, WHO Collaborating Centre for Drug Utilization Research and Clinical Pharmacological Services. 2003.
- **40** Harpe S. Using secondary data sources for pharmacoeepidemiology and outcomes research. *Pharmacotherapy*. 2009;**29**(2):138–53.
- **41** Takahashi Y, Nishida Y, Asai S. Utilization of health care databases for pharmacoepidemiology. *European Journal of Clinical Pharmacology*. 2012;**68**(2):123–9.
- **42** Widdifield J, Bernatsky S, Paterson J, et al. Accuracy of Canadian health administrative databases in identifying patients with rheumatoid arthritis: a validation study using the medical records of

- rheumatologists. *Arthritis Care Research (Hoboken)*. 2013:**65**(10):1582–91.
- Rikala M, Hartikainen S, Sulkava R, Korhonen M. Validity of the Finnish prescription register for measuring psychotropic drug exposures among elderly Finns: a population-based intervention study. *Drugs Aging*. 2010;**27**(4):337–49.
- **44** Noize P, Bazin F, Dufouil C, et al. Comparison of health insurance claims and patient interviews in assessing drug use: data from the Three-City (3C) Study. *Pharmacoepidemiol Drug Safety*. 2009;**18**(4):310–19.
- Haukka J, Suvisaari J, Tuulio-Henriksson A, Lönnqvist J. High concordance between self-reported medication and official prescription database information. *European Journal of Clinical Pharmacology*. 2007:**63**:1069–74.
- Goettsch W, Heintjes E, Kastelein J, Rabelink T, Johansson S, Herings R. Results from a rosuvastatin historical cohort study in more than 45 000 Dutch statin users, a PHARMO study. *Pharmacoepidemiol Drug Safety*. 2006;**15**:435–43.
- Harwood E, Vang P. Data collection methods series. Part 1: define a clear purpose for collecting data. *Journal of Wound, Ostomy, and Continence Nursing.* 2009;**36**(1):15–19.
- **48** Harwood E. Data collection methods series. Part 3: developing protocols for collecting data. *Journal of Wound, Ostomy, and Continence Nursing*. 2009;**36**(3):246–50.
- Harwood E, Hutchinson E. Data collection methods series. Part 6: managing collected data. *Journal of Wound, Ostomy, and Continence Nursing*. 2009;**36**(6):592–9.
- 50 Harwood E, Hutchinson E. Data collection methods series. Part 2: select the most feasible data collection mode. *Journal of Wound, Ostomy, and Continence Nurs*ing. 2009;36(2):129–35.
- Harwood E, Hutchinson E. Data collection methods series. Part 5: training for data collection. *Journal of Wound, Ostomy, and Continence Nursing.* 2009;36(5):476–81.
- Hutchinson E, Harwood E. Data collection methods series. Part 4: designing forms and instruments. *Journal of Wound, Ostomy, and Continence Nursing.* 2009;**36**(4):371–5.
- Doody O, Noonan M. Preparing and conducting interviews to collect data. *Nurse Researcher*. 2013;**20**(5):28–32.

- Pan L, Fergusson D, Schweitzer I, Hebert P. Ensuring high accuracy of data abstracted from patient charts: the use of a standardized medical record as a training tool. *Journal of Clinical Epidemiology*. 2005;**58**(9):918–23.
- **55** Reisch L, Fosse J, Beverly K, et al. Training, quality assurance, and assessment of medical record abstraction in a multisite study. *American Journal of Epidemiology*. 2003;**157**(6):546–51.
- **56** Murray P. Fundamental issues in questionnaire design. *Accident and Emergency Nursing*. 1999;**7**(3):148–53.
- Kimberlin C, Winterstein A. Validity and reliability of measurement instruments used in research. *American Journal of Health Systems Pharmacy*. 2008;**65**(23):2276–84.
- Rattray J, Jones M. Essential elements of questionnaire design and development. *Journal of Clinical Nursing*. 2007;**16**(2):234–43.
- Marshall G. The purpose, design and administration of a questionnaire for data collection. *Radiography*. 2005;**11**(2):131–6.
- Carr A, Higginson I. Are quality of life measures patient centred? *British Medical Journal*. 2001;**322**(7298):1357–60.
- Schechter S. Questionnaire design. In: Armitage P, Colton T, eds. *Encyclopedia of Biostatistics*, 2nd edn. Chichester, John Wiley & Sons, 2005.
- Edwards P. Questionnaires in clinical trials: guidelines for optimal design and administration. *Trials*. 2010:**11**:2.
- **63** Burns K, Duffett M, Kho M, et al. A guide for the design and conduct of self-administered surveys of clinicians. *CMAJ.* 2008;**179**(3):245–52.
- Streiner D, Norman G., Cairney J *Health Measurement Scales: A Practical Guide to their Development and Use*, 5th edn. Oxford, Oxford University Press, 2015.
- Oppenheim A. *Questionnaire Design, Interviewing and Attitude Measurement.* London, Continuum, 1992.
- Ritchie J, Lewis J. *Qualitative Research Practice: A Guide for Social Science Students and Researchers*. London, SAGE Publications, 2003.
- Epstein J, Santo RM, Guillemin F. A review of guidelines for cross-cultural adaptation of questionnaires could not bring out a consensus. *J Clin Epidemiol*. 2015 Apr;68(4):435–41.
- Uijen AA, Heinst CW, Schellevis FG, van den Bosch WJ, van de Laar FA, Terwee CB, Schers HJ. Measurement properties of questionnaires measuring

- continuity of care: a systematic review. *PLoS ONE*. 2012;**7**(7):e42256.
- **69** Reeve BB, Wyrwich KW, Wu AW, et al. ISOQOL recommends minimum standards for patient-reported outcome measures used in patient-centered outcomes and comparative effectiveness research. *Quality of Life Research*. 2013;**22**(8):1889–905.
- **70** Gama H, Correia S, Lunet N. Questionnaire design and the recall of pharmacological treatments: a systematic review. *Pharmacoepidemiological Drug Safety*. 2009;**18**(3):175–87.
- 71 Bertoldi A, Barros A, Wagner A, Ross-Degnan D, Hallal P. A descriptive review of the methodologies used in household surveys on medicine utilization. BMC Health Services Research. 2008;8:222.
- **72** Boynton P, Greenhalgh T. Selecting, designing, and developing your questionnaire. *British Medical Journal*. 2004;**328**(7451):1312–15.
- 73 Chaipichit N, Krska J, Pratipanawatr T, Uchaipichat V, Jarernsiripornkul N. A qualitative study to explore how patients identify and assess symptoms as adverse drug reactions. *European Journal of Clinical Pharmacology*. 2014;70(5):607–15.
- 74 Luz T, Loyola Filho A, Lima-Costa M. Social capital and under-utilization of medication for financial reasons among elderly women: evidence from two Brazilian health surveys. *Cien Saude Colet*. 2013;18(12):3721–30.
- 75 Van Bever E, Elseviers M, Plovie M, Vandeputte L, Van Bortel L, Vander Stichele R. Attitudes of physicians and pharmacists towards international non-proprietary name prescribing in Belgium. *Basic & Clinical Pharmacology & Toxicology*. 2015;116(3):264–72.
- **76** Piette J, Wagner T, Potter M, Schillinger D. Health insurance status, cost-related medication underuse, and outcomes among diabetes patients in three systems of care. *Medical Care*. 2004;**42**(2):102–9.
- 77 Willke RJ, Burke LB, Erickson P. Measuring treatment impact: a review of patient-reported outcomes and other efficacy endpoints in approved product labels. *Controlled Clinical Trials*. 2004;25(6):535–52.
- **78** Davidson M, Keating J. Patient-reported outcome measures (PROMs): how should I interpret reports of measurement properties? A practical guide for clinicians and researchers who are not biostatisticians. *British Journal of Sports Medicine*. 2014;**48**(9):792–6.
- **79** Anker S, Agewall S, Borggrefe M, et al. The importance of patient-reported outcomes: a call for their

- comprehensive integration in cardiovascular clinical trials. *European Heart Journal*. 2014;**35**(30):2001–9.
- **80** Giesinger K, Hamilton D, Jost B, Holzner B, Giesinger J. Comparative responsiveness of outcome measures for total knee arthroplasty. Osteoarthritis Cartilage. 2014;**22**(2):184–9.
- **81** Cella D, Gershon R, Lai JS, Choi S. The future of outcomes measurement: item banking, tailored short-forms, and computerized adaptive assessment. *Quality of Life Research*. 2007;**16**(Suppl. 1):133–41.
- **82** Rothman ML, Beltran P, Cappelleri JC, Lipscomb J, Teschendorf B; Mayo/FDA Patient-Reported Outcomes Consensus Meeting Group. Patient-reported outcomes: conceptual issues. *Value Health*. 2007;**10**(Suppl. 2):S66–75.
- **83** EuroQol Group. EuroQol a new facility for the measurement of health-related quality of life. *Health Policy*. 1990;**16**(3):199–208.
- **84** Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Medical Care*. 1992;**30**(6):473–83.
- **85** Brazier J, Roberts J, Deverill M. The estimation of a preference-based measure of health from the SF-36. *Journal of Health Economics*. 2002;**21**(2):271–92.
- **86** Valderas JM, Ferrer M, Mendívil J, Garin O, Rajmil L, Herdman M, Alonso J; Scientific Committee on 'Patient-Reported Outcomes' of the IRYSS Network. Development of EMPRO: A tool for the standardized assessment of patient-reported outcome measures. *Value in Health*. 2008;**11**(4):700–8.
- 87 Food and Drug Administration/Center for Drug Evaluation and Research. Guidance for Industry. Patient-Reported Outcome Measures: Use in Medical Product Development to Support Labeling Claims. FDA, 2009. Available from: http://www.fda.gov/downloads/Drugs/GuidanceComplianceRegulatoryInformation/Guidances/UCM193282.pdf9 (last accessed 18 November 2015).
- **88** Snyder CF, Watson ME, Jackson JD, Cella D, Halyard MY; Mayo/FDA Patient-Reported Outcomes Consensus Meeting Group. Patient-reported outcome instrument selection: designing a measurement strategy. *Value in Health*. 2007;**10**(Suppl. 2):S76–85.
- **89** Basch E. New frontiers in patient-reported outcomes: adverse event reporting, comparative effectiveness, and quality assessment. *Annual Review of Medicine*. 2014;**65**:307–17.

- **90** Calvert M, Kyte D, Duffy H, et al. Patient-reported outcome (PRO) assessment in clinical trials: a systematic review of guidance for trial protocol writers. *PLoS ONE*. 2014;**9**(10):e110216.
- 91 World Health Organization. Standards and Operational Guidance for Ethics Review of Health-Related Research with Human Participants 2011. Available from: http://whqlibdoc.who.int/publications/2011/9789241502948_eng.pdf?ua=1 (last accessed 18 November 2015).
- **92** Persaud I. Field study. In: Salkind NJ, ed. *Encyclopedia of Research Design*. Sage Publications, 2010: 489–91.
- 93 World Health Organization and Council for International Organizations of Medical Sciences. *International Ethical Guidelines for Biomedical Research Involving Human Subjects*. Geneva, World Health Organization, 2002. Available from: http://www.cioms.ch/publications/layout_guide2002.pdf (last accessed 18 November 2015).
- **94** World Medical Association. *Declaration of Helsinki Ethical Principles for Medical Research Involving Human Subjects.* World Medical Association, 1964. Available from: http://www.wma.net/en/30publications/10policies/b3/ (last accessed 18 November 2015).

- 1 Bergman U, Elmes P, Halse M, Halvorsen T, Hood H, Lunde PK, et al. The measurement of drug consumption. Drugs for diabetes in Northern Ireland, Norway and Sweden. *European Journal of Clinical Pharmacology*. 1975;8(2):83–9.
- 2 Nordic Council of Medicine. *Nordic Statistics on Medicines 1975–1977, Parts I, II. Statistical Reports of the Nordic Countries, Nos 35, 36.* Helsinki and Oslo, Nordic Council of Medicine, 1979.
- **3** WHO Collaborating Centre for Drug Statistics Methodology. *Guidelines for ATC Classification and DDD Assignment, 2015.* Oslo, World Health Organization, 2014.
- **4** Ferrer P, Ballarin E, Sabate M, Laporte JR, Schoonen M, Rottenkolber M, et al. Sources of European drug consumption data at a country level. *International Journal of Public Health*. 2014;**59**(5):877–87.
- **5** Sabate M, Ferrer P, Ballarin E, Rottenkolber M, Amelio J, Schmiedl S, et al. Inpatient drug utilization in Europe: nationwide data sources and a review of publications on a selected group of medicines (PROTECT project). *Basic Clinical Pharmacology and Toxicology*, **2015**;**116**(3):201–11.
- 6 IMS Health website: www.imshealth.com.
- 7 Leopold C, Zhang F, Mantel-Teeuwisse AK, Vogler S, Valkova S, Ross-Degnan D, et al. Impact of pharmaceutical policy interventions on utilization of antipsychotic medicines in Finland and Portugal in times of economic recession: interrupted time series analyses. *International Journal for Equity in Health*. 2014;13:53.
- **8** O'Neill P, Sussex J. *International Comparison of Medicines Usage: Quantitative Analysis.* London, Office of Health Economics, 2014.
- **9** Van Boeckel TP, Gandra S, Ashok A, Caudron Q, Grenfell BT, Levin SA, et al. Global antibiotic con-

- sumption 2000 to 2010: an analysis of national pharmaceutical sales data. *Lancet Infectious Diseases*. 2014;**14**(8):742–50.
- 10 Wettermark B, Persson ME, Wilking N, Kalin M, Korkmaz S, Hjemdahl P, et al. Forecasting drug utilization and expenditure in a metropolitan health region. *BMC Health Services Research*. 2010;10:128.
- 11 Bergman U, Boman G, Wiholm BE. Epidemiology of adverse drug reactions to phenformin and metformin. *British Medical Journal*. 1978;**2**(6135):464–6.
- **12** Telfair T, Mohan AK, Shahani S, Klincewicz S, Atsma WJ, Thomas A, et al. Estimating post-marketing exposure to pharmaceutical products using ex-factory distribution data. *Pharmacoepidemiology and Drug Safety*. 2006;**15**(10):749–53.
- 13 von Euler M, Keshani S, Baatz K, Wettermark B. Utilization of triptans in Sweden; analyses of over the counter and prescription sales. *Pharmacoepidemiology and Drug Safety.* 2014;23(12):1288–93.
- **14** Modarai F, Mack K, Hicks P, Benoit S, Park S, Jones C, et al. Relationship of opioid prescription sales and overdoses, North Carolina. *Drug and Alcohol Dependence*. 2013;**132**(1–2):81–6.
- **15** Bramness JG, Walby FA, Tverdal A. The sales of antidepressants and suicide rates in Norway and its counties 1980–2004. *Journal of Affective Disorders*. 2007;**102**(1–3):1–9.
- **16** Goossens H, Ferech M, Vander Stichele R, Elseviers M. Outpatient antibiotic use in Europe and association with resistance: a cross-national database study. *Lancet.* 2005;**365**(9459):579–87.
- **17** The American Health Information Management Association website: www.ahima.org.
- **18** Coorevits P, Sundgren M, Klein GO, Bahr A, Claerhout B, Daniel C, et al. Electronic health records: new opportunities for clinical research. *Journal of Internal Medicine*. 2013;**274**(6):547–60.

- 19 Friedberg MW, Chen PG, Busum KRV, Aunon F, Pham C, Caloyeras J, et al. *Factors Affecting Physician Professional Satisfaction and their Implications for Patient Care, Health Systems, and Health Policy.* Santa Monica, CA, RAND Corporation, 2013.
- **20** DesRoches CM, Campbell EG, Rao SR, Donelan K, Ferris TG, Jha A, et al. Electronic health records in ambulatory care a national survey of physicians. *New England Journal of Medicine*. 2008;**359**(1):50–60.
- **21** Blumenthal D. Stimulating the adoption of health information technology. *New England Journal of Medicine*. 2009;**360**(15):1477–9.
- Simborg DW, Detmer DE, Berner ES. The wave has finally broken: now what? *Journal of the American Medical Informatics Association*. 2013;**20**(e1):e21–5.
- **23** Blaya JA, Fraser HS, Holt B. E-health technologies show promise in developing countries. *Health Affairs* (*Project Hope*). 2010;**29**(2):244–51.
- Cooke CE, Xing S, Lee HY, Belletti DA. You wrote the prescription, but will it get filled? *Journal of Family Practice*. 2011;**60**(6):321–7.
- Zweigoron RT, Binns HJ, Tanz RR. Unfilled prescriptions in pediatric primary care. *Pediatrics*. 2012;**130**(4):620–6.
- **26** Rusanov A, Weiskopf NG, Wang S, Weng C. Hidden in plain sight: bias towards sick patients when sampling patients with sufficient electronic health record data for research. *BMC Medical Informatics and Decision Making*. 2014;**14**:51.
- Individdata om rekvisitionsläkemedel: uppföljning, dokumentation och informatik. *Nationella läkemedelsstrategin, område 6.4, slutrapport.* Stockholm, Sveriges Kommuner och Landsting, 2015.
- 28 Holbrook A, Grootendorst P, Willison D, Goldsmith C, Sebaldt R, Keshavjee K. Can current electronic systems meet drug safety and effectiveness requirements? *AMIA Annual Symposium Proceedings/ AMIA Symposium AMIA Symposium*. 2005:335–9.
- Jick H, Jick SS, Derby LE. Validation of information recorded on general practitioner based computerised data resource in the United Kingdom. *British Medical Journal (Clinical Research Edition)*. 1991;**302**(6779):766–8.
- Johnson N, Mant D, Jones L, Randall T. Use of computerised general practice data for population surveillance: comparative study of influenza data. *British Medical Journal (Clinical Research Edition)*. 1991;**302**(6779):763–5.

- Hall GC, Luscombe DK, Walker SR. Post-marketing surveillance using a computerised general practice data base. *Pharmaceutical Medicine*. 1988;**2**(4): 345–51.
- Williams T, van Staa T, Puri S, Eaton S. Recent advances in the utility and use of the General Practice Research Database as an example of a UK Primary Care Data resource. *Therapeutic Advances in Drug Safety.* 2012;**3**(2):89–99.
- **33** Lewis JD, Schinnar R, Bilker WB, Wang X, Strom BL. Validation studies of the health improvement network (THIN) database for pharmacoepidemiology research. *Pharmacoepidemiology and Drug Safety*. 2007;**16**(4):393–401.
- Hippisley-Cox J, Stables D, Pringle M. QRESEARCH: a new general practice database for research. *Informatics in Primary Care*. 2004;**12**(1):49–50.
- Vlug AE, van der Lei J, Mosseveld BM, van Wijk MA, van der Linden PD, Sturkenboom MC, et al. Postmarketing surveillance based on electronic patient records: the IPCI project. *Methods of Information in Medicine*. 1999;**38**(4–5):339–44.
- Hjerpe P, Merlo J, Ohlsson H, Bengtsson Bostrom K, Lindblad U. Validity of registration of ICD codes and prescriptions in a research database in Swedish primary care: a cross-sectional study in Skaraborg primary care database. *BMC Medical Informatics and Decision Making*. 2010;**10**:23.
- Tu K, Mitiku TF, Ivers NM, Guo H, Lu H, Jaakkimainen L, et al. Evaluation of Electronic Medical Record Administrative data Linked Database (EMRALD). *American Journal of Managed Care*. 2014;**20**(1):e15–21.
- Sultana J, Italiano D, Spina E, Cricelli C, Lapi F, Pecchioli S, et al. Changes in the prescribing pattern of antidepressant drugs in elderly patients: an Italian, nationwide, population-based study. *European Journal of Clinical Pharmacology*. 2014;**70**(4):469–78.
- Baiardi P, Ceci A, Felisi M, Cantarutti L, Girotto S, Sturkenboom M, et al. In-label and off-label use of respiratory drugs in the Italian paediatric population. *Acta Paediatrica*. 2010;**99**(4):544–9.
- **40** Erviti J, Alonso A, Oliva B, Gorricho J, Lopez A, Timoner J, et al. Oral bisphosphonates are associated with increased risk of subtrochanteric and diaphyseal fractures in elderly women: a nested case-control study. *British Medical Journal Open*. 2013;**3**(1).

- **41** Pace WD, Cifuentes M, Valuck RJ, Staton EW, Brandt EC, West DR. An electronic practice-based network for observational comparative effectiveness research. *Annals of Internal Medicine*. 2009;**151**(5):338–40.
- **42** Gill JM, Klinkman MS, Chen YX. Antidepressant medication use for primary care patients with and without medical comorbidities: a national electronic health record (EHR) network study. *Journal of the American Board of Family Medicine*. 2010;**23**(4): 499–508.
- **43** Smith MW, Joseph GJ. Pharmacy data in the VA health care system. *Medical Care Research and Review*. 2003;**60**(3 Suppl.):92S–123S.
- **44** Higginson IJ, Gao W. Opioid prescribing for cancer pain during the last 3 months of life: associated factors and 9-year trends in a nationwide United Kingdom cohort study. *Journal of Clinical Oncology*. 2012;**30**(35):4373–9.
- **45** Wijlaars LP, Nazareth I, Petersen I. Trends in depression and antidepressant prescribing in children and adolescents: a cohort study in The Health Improvement Network (THIN). *PLoS ONE*. 2012;**7**(3):e33181.
- **46** Verhamme KM, Afonso A, Romio S, Stricker BC, Brusselle GG, Sturkenboom MC. Use of tiotropium Respimat Soft Mist Inhaler versus HandiHaler and mortality in patients with COPD. *European Respiratory Journal*. 2013;**42**(3):606–15.
- **47** Larsen MD, Cars T, Hallas J. A MiniReview of the use of hospital-based databases in observational inpatient studies of drugs. *Basic Clin Pharmacol Toxicol*. 2013;**112**(1):13–18.
- **48** Cars T, Wettermark B, Malmstrom RE, Ekeving G, Vikstrom B, Bergman U, et al. Extraction of electronic health record data in a hospital setting: comparison of automatic and semi-automatic methods using anti-TNF therapy as model. *Basic Clinical Pharmacology & Toxicology*. 2013;**112**(6):392–400.
- **49** Yoon D, Park I, Schuemie MJ, Park MY, Kim JH, Park RW. A quantitative method for assessment of prescribing patterns using electronic health records. *PLoS ONE*. 2013;**8**(10):e75214.
- **50** Ng WY, Cheung CM, Mathur R, Chan CM, Yeo IY, Wong E, et al. Trends in age-related macular degeneration management in Singapore. *Optometry and Vision Science*. 2014;**91**(8):872–7.

- **51** Yang H, Chaudhari P, Zhou ZY, Wu EQ, Patel C, Horn DL. Budget impact analysis of liposomal amphotericin B and amphotericin B lipid complex in the treatment of invasive fungal infections in the United States. *Applied Health Economics and Health Policy*. 2014;**12**(1):85–93.
- **52** Lasky T, Ernst FR, Greenspan J, Wang S, Gonzalez L. Estimating pediatric inpatient medication use in the United States. *Pharmacoepidemiology and Drug Safety.* 2011;**20**(1):76–82.
- 53 Kavcic M, Fisher BT, Seif AE, Li Y, Huang YS, Walker D, et al. Leveraging administrative data to monitor rituximab use in 2875 patients at 42 freestanding children's hospitals across the United States. *Journal of Pediatrics*. 2013;162(6):1252–8, 8 e1.
- **54** Miller LA, Burudpakdee C, Zagar A, Bhosle M, Reaney M, Schabert VF, et al. Exenatide BID and liraglutide QD treatment patterns among type 2 diabetes patients in Germany. *Journal of Medical Economics*. 2012;**15**(4):746–57.
- 55 Lee WC, Smith E, Chubb B, Wolden ML. Frequency of blood glucose testing among insulin-treated diabetes mellitus patients in the United Kingdom. *Journal of Medical Economics*. 2014;17(3):167–75.
- 56 Wettermark B, Hammar N, Fored CM, Leimanis A, Otterblad Olausson P, Bergman U, et al. The new Swedish Prescribed Drug Register opportunities for pharmacoepidemiological research and experience from the first six months. *Pharmacoepidemiology and Drug Safety*. 2007;16(7):726–35.
- **57** Reutfors J, Brandt L, Stephansson O, Kieler H, Andersen M, Boden R. Antipsychotic prescription filling in patients with schizophrenia or schizoaffective disorder. *Journal of Clinical Psychopharmacology*. 2013;**33**(6):759–65.
- **58** IMS Hospital Treatment Insights website: www. imshealth.com.
- 59 Loikas D, Wettermark B, von Euler M, Bergman U, Schenck-Gustafsson K. Differences in drug utilisation between men and women: a cross-sectional analysis of all dispensed drugs in Sweden. *British Medical Journal Open.* 2013;3(5).
- **60** Pottegard A, Bjerregaard BK, Larsen MD, Larsen KS, Hallas J, Knop FK, et al. Use of exenatide and liraglutide in Denmark: a drug utilization study. *European Journal of Clinical Pharmacology*. 2014;**70**(2):205–14.
- **61** Ruiter R, Visser LE, van Herk-Sukel MP, Geelhoed-Duijvestijn PH, de Bie S, Straus SM, et

- al. Prescribing of rosiglitazone and pioglitazone following safety signals: analysis of trends in dispensing patterns in the Netherlands from 1998 to 2008. *Drug Safety.* 2012;**35**(6):471–80.
- **62** Horsburgh S, Norris P, Becket G, Arroll B, Crampton P, Cumming J, et al. Allopurinol use in a New Zealand population: prevalence and adherence. *Rheumatology International*. 2014;**34**(7):963–70.
- 63 Seiter A. A Practical Approach to Pharmaceutical Policy. Washington, DC, The World Bank, 2010.
- **64** Williams D, Feely J. Pharmacoepidemiology an Irish perspective. *Pharmacoepidemiology and Drug Safety*. 2001;**10**(7):641–5.
- **65** Hux JE, Kopp A, Mamdani MM. Turning 65 in Ontario: the impact of public drug benefit coverage on hospitalizations for acute and chronic disease. *Healthcare Policy = Politiques de sante.* 2006;**1**(3): 87–98.
- 66 Laki J, Monok G, Palosi M, Gajdacsi JZ. Economical aspect of biological therapy in inflammatory conditions in Hungary. Expert Opinion on Biological Therapy. 2013;13(3):327–37.
- **67** Holmes HM, Luo R, Kuo YF, Baillargeon J, Goodwin JS. Association of potentially inappropriate medication use with patient and prescriber characteristics in Medicare Part D. *Pharmacoepidemiology and Drug Safety*. 2013;**22**(7):728–34.
- **68** Schneeweiss S, Avorn J. A review of uses of health care utilization databases for epidemiologic research on therapeutics. *Journal of Clinical Epidemiology*. 2005;**58**(4):323–37.
- 69 Crystal S, Akincigil A, Bilder S, Walkup JT. Studying prescription drug use and outcomes with medicaid claims data: strengths, limitations, and strategies. *Medical Care*. 2007;45(10 Supl. 2):S58–65.
- **70** Kimura T, Matsushita Y, Yang YH, Choi NK, Park BJ. Pharmacovigilance systems and databases in Korea, Japan, and Taiwan. *Pharmacoepidemiology and Drug Safety*. 2011;**20**(12):1237–45.
- 71 Smets HL, De Haes JF, De Swaef A, Jorens PG, Verpooten GA. Exposure of the elderly to potential nephrotoxic drug combinations in Belgium. *Pharmacoepidemiology and Drug Safety*. 2008;17(10):1014–19.
- **72** Lass J, Irs A, Pisarev H, Leinemann T, Lutsar I. Off label use of prescription medicines in children in outpatient setting in Estonia is common. *Pharmacoepidemiology and Drug Safety*. 2011;**20**(5):474–81.

- 73 Alessi-Severini S, Biscontri RG, Collins DM, Sareen J, Enns MW. Ten years of antipsychotic prescribing to children: a Canadian population-based study. *Canadian Journal of Psychiatry/Revue canadienne de psychiatrie*. 2012;57(1):52–8.
- **74** Kim JY, Kim HJ, Jung SY, Kim KI, Song HJ, Lee JY, et al. Utilization of evidence-based treatment in elderly patients with chronic heart failure: using Korean Health Insurance claims database. *BMC Cardiovascular Disorders*. 2012;**12**:60.
- **75** Zhang Y, Steinman MA, Kaplan CM. Geographic variation in outpatient antibiotic prescribing among older adults. *Archives of Internal Medicine*. 2012;**172**(19):1465–71.
- **76** Zilkens RR, Duke J, Horner B, Semmens JB, Bruce DG. Australian population trends and disparities in cholinesterase inhibitor use, 2003 to 2010. *Alzheimer's & Dementia*. 2014;**10**(3):310–18.
- 77 Cheng CL, Kao Yang YH, Liu CC, Lee PI. A retrospective study on the usage of cough and cold medications in viral respiratory tract infections in Taiwanese children. *Pharmacoepidemiology and Drug Safety*. 2014;**23**(1):36–42.
- **78** Chancellor MB, Migliaccio-Walle K, Bramley TJ, Chaudhari SL, Corbell C, Globe D. Long-term patterns of use and treatment failure with anticholinergic agents for overactive bladder. *Clinical Therapeutics*. 2013;**35**(11):1744–51.
- 79 Law MR, Lu CY, Soumerai SB, Graves AJ, LeCates RF, Zhang F, et al. Impact of two Medicaid prior-authorization policies on antihypertensive use and costs among Michigan and Indiana residents dually enrolled in Medicaid and Medicare: results of a longitudinal, population-based study. *Clinical Therapeutics*. 2010;32(4):729–41; disc. 16.
- **80** Gliklich R, Dreyer N, Leavy M, eds. *Registries for Evaluating Patient Outcomes: A User's Guide*, 3rd edn. Prepared by the Outcome DEcIDE Center (Outcome Sciences, Inc., a Quintiles company) under Contract No. 290 2005 00351 TO7. AHRQ Publication No. 13(14)-EHC111. Rockville, MD, Agency for Healthcare Research and Quality, 2014.
- **81** Andersen O. From the Gothenburg cohort to the Swedish multiple sclerosis registry. *Acta Neurologica Scandinavica Supplementum*. 2012;**195**:13–19.
- **82** Silman A, Symmons D, Scott DG, Griffiths I. British Society for Rheumatology Biologics Register. *Annals of the Rheumatic Diseases*. 2003;**62**(Suppl. 2):ii28–9.

- **83** Emilsson L, Lindahl B, Koster M, Lambe M, Ludvigsson JF. Review of 103 Swedish healthcare quality registries. *Journal of Internal Medicine*. 2015;**277**(1):94–136.
- **84** Huisman MV, Lip GY, Diener HC, Dubner SJ, Halperin JL, Ma CS, et al. Design and rationale of Global Registry on Long-Term Oral Antithrombotic Treatment in Patients with Atrial Fibrillation: a global registry program on long-term oral antithrombotic treatment in patients with atrial fibrillation. *American Heart Journal*. 2014;**167**(3):329–34.
- **85** Travers K, Sallum RH, Burns MD, Barr CE, Beattie MS, Pashos CL, et al. Characteristics and temporal trends in patient registries: focus on the life sciences industry, 1981–2012. *Pharmacoepidemiology and Drug Safety*. 2015;**24**(4):389–98.
- **86** Garattini L, Casadei G. Risk sharing agreements: what lessons from Italy? *International Journal of Technology Assessment in Health Care*. 2011;**27**(2):169–72.
- **87** Neovius M, Arkema EV, Olsson H, Eriksson JK, Kristensen LE, Simard JF, et al. Drug survival on TNF inhibitors in patients with rheumatoid arthritis comparison of adalimumab, etanercept and infliximab. *Annals of the Rheumatic Diseases*. 2015;**74**(2):354–60.
- **88** Arkema EV, Neovius M, Joelsson JK, Simard JF, van Vollenhoven RF. Is there a sex bias in prescribing anti-tumour necrosis factor medications to patients with rheumatoid arthritis? A nation-wide cross-sectional study. *Annals of the Rheumatic Diseases*. 2012;**71**(7):1203–6.
- **89** Southwood TR, Foster HE, Davidson JE, Hyrich KL, Cotter CB, Wedderburn LR, et al. Duration of etanercept treatment and reasons for discontinuation in a cohort of juvenile idiopathic arthritis patients. *Rheumatology (Oxford, England)*. 2011;**50**(1):189–95.
- **90** Strangfeld A, Hyrich K, Askling J, Arkema E, Davies R, Listing J, et al. Detection and evaluation of a drug safety signal concerning pancreatic cancer: lessons from a joint approach of three European biologics registers. *Rheumatology (Oxford, England)*. 2011;**50**(1):146–51.
- **91** Kalincik T, Spelman T, Trojano M, Duquette P, Izquierdo G, Grammond P, et al. Persistence on therapy and propensity matched outcome comparison of two subcutaneous interferon beta 1a dosages for multiple sclerosis. *PLoS ONE*. 2013;**8**(5):e63480.

- **92** Raaschou P, Simard JF, Holmqvist M, Askling J. Rheumatoid arthritis, anti-tumour necrosis factor therapy, and risk of malignant melanoma: nationwide population based prospective cohort study from Sweden. *British Medical Journal (Clinical Research Edition)*. 2013;**346**:f1939.
- **93** Cannon GW, DuVall SL, Haroldsen CL, Caplan L, Curtis JR, Michaud K, et al. Persistence and dose escalation of tumor necrosis factor inhibitors in US veterans with rheumatoid arthritis. *Journal of Rheumatology*. 2014;**41**(10):1935–43.
- **94** Boo S, Froelicher ES. Secondary analysis of national survey datasets. *Japan Journal of Nursing Science*. 2013;**10**(1):130–5.
- **95** Kirking DM, Lee JA, Ellis JJ, Briesacher B, McKercher PL. Patient-reported underuse of prescription medications: a comparison of nine surveys. *Medical Care Research and Review.* 2006;**63**(4):427–46.
- **96** Kennedy J, Tuleu I, Mackay K. Unfilled prescriptions of medicare beneficiaries: prevalence, reasons, and types of medicines prescribed. *Journal of Managed Care Pharmacy*. 2008;**14**(6):553–60.
- **97** The National Health and Nutrition Examination Survey. Centers for Disease Control and Prevention, National Center for Health Statistics. Available from: http://www.cdc.gov/nchs/nhanes.htm (last accessed 18 November 2015).
- **98** Plantinga L, Grubbs V, Sarkar U, Hsu CY, Hedgeman E, Robinson B, et al. Nonsteroidal anti-inflammatory drug use among persons with chronic kidney disease in the United States. *Annals of Family Medicine*. 2011;**9**(5):423–30.
- **99** Sprague BL, Trentham-Dietz A, Cronin KA. A sustained decline in postmenopausal hormone use: results from the National Health and Nutrition Examination Survey, 1999–2010. *Obstetrics and Gynecology*. 2012;**120**(3):595–603.
- 100 Mojtabai R, Olfson M. National trends in long-term use of antidepressant medications: results from the US National Health and Nutrition Examination Survey. *Journal of Clinical Psychiatry*. 2014;**75**(2):169–77.
- **101** Grijalva CG, Nuorti JP, Griffin MR. Antibiotic prescription rates for acute respiratory tract infections in US ambulatory settings. *Journal of the American Medical Association*. 2009;**302**(7):758–66.
- **102** Balkrishnan R, Bhosle MJ, Camacho F, Fleischer AB, Feldman SR. Prescribing patterns for topical retinoids: analyses of 15 years of data from the

- national ambulatory medical care survey. *Journal of Dermatological Treatment*. 2010;**21**(3):193–200.
- **103** Copp HL, Shapiro DJ, Hersh AL. National ambulatory antibiotic prescribing patterns for pediatric urinary tract infection, 1998–2007. *Pediatrics*. 2011;**127**(6):1027–33.
- **104** Tay KY, Ewald MB, Bourgeois FT. Use of QT-prolonging medications in US emergency departments, 1995–2009. *Pharmacoepidemiology and Drug Safety*. 2014;**23**(1):9–17.
- 105 Eurostat. European Health Interview Survey. Available from: http://ec.europa.eu/eurostat/web/microdata/european-health-interview-survey (last accessed 18 November 2015).
- **106** Kopp M, Fleischhacker WW, Sturz K, Ruedl G, Kumnig M, Rumpold G. Poor health behaviour and reduced quality of life of people treated with psychotropic drugs. *Human Psychopharmacology*. 2011;**26**(2):161–7.
- 107 Carrasco-Garrido P, de Andres AL, Barrera VH, Jimenez-Trujillo I, Fernandez-de-Las-Penas C, Palacios-Cena D, et al. Predictive factors of self-medicated analgesic use in Spanish adults: a cross-sectional national study. *BMC Pharmacology & Toxicology*. 2014;15:36.
- 108 Wirtz VJ, Russo G, Kageyama-Escobar M de L. Access to medicines by ambulatory health service users in Mexico: an analysis of the national health surveys 1994 to 2006. *Salud publica de Mexico*. 2010;52(1):30–8.
- **109** Armstrong AR, Thiebaut SP, Brown LJ, Nepal B. Australian adults use complementary and alternative medicine in the treatment of chronic illness: a national study. *Australian and New Zealand Journal of Public Health*. 2011;**35**(4):384–90.
- **110** Dunn HL. Record linkage. *American Journal of Public Health and the Nation's Health*. 1946;**36**(12):1412–16.
- **111** Howe GR. Use of computerized record linkage in cohort studies. *Epidemiologic Reviews*. 1998;**20**(1):112–21.
- **112** Jutte DP, Roos LL, Brownell MD. Administrative record linkage as a tool for public health research. *Annual Review of Public Health*. 2011;**32**:91–108.
- 113 Herk-Sukel MP, Lemmens VE, Poll-Franse LV, Herings RM, Coebergh JW. Record linkage for pharmacoepidemiological studies in cancer patients. *Pharmacoepidemiology and Drug Safety*. 2012;**21**(1):94–103.

- 114 Wettermark B, Zoega H, Furu K, Korhonen M, Hallas J, Norgaard M, et al. The Nordic prescription databases as a resource for pharmacoepidemiological research a literature review. *Pharmacoepidemiology and Drug Safety*. 2013;22(7):691–9.
- 115 Furu K, Wettermark B, Andersen M, Martikainen JE, Almarsdottir AB, Sorensen HT. The Nordic countries as a cohort for pharmacoepidemiological research. *Basic Clinical Pharmacology & Toxicology*. 2010;106(2):86–94.
- Boyd JH, Randall SM, Ferrante AM, Bauer JK, Brown AP, Semmens JB. Technical challenges of providing record linkage services for research. BMC Medical Informatics and Decision Making. 2014;14:23.
- 117 Rognehaugh R. The Health Information Technology Dictionary. Gaithersburg, MD, Aspen, 1999.
- 118 The National Academies Collection: reports funded by National Institutes of Health. In: Nass SJ, Levit LA, Gostin LO, eds. *Beyond the HIPAA Privacy Rule: Enhancing Privacy, Improving Health Through Research*. Washington, DC, National Academies Press, National Academy of Sciences, 2009.
- 119 Turn R, Ware WH. *Privacy and Security Issues in Information Systems*. Santa Monica, CA, The RAND Corporation, 1976.
- **120** Mizani MA, Baykal N. Policymaking to preserve privacy in disclosure of public health data: a suggested framework. *Journal of Medical Ethics*. 2015;**41**(3):263–7.
- 121 EU data protection reform: Council confirms agreement with the European Parliament Consilium [Internet]. 2016 [cited 7 February 2016]. Available from: http://www.consilium.europa.eu/en/press/press-releases/2015/12/18-data-protection/
- **122** Gunn PP, Fremont AM, Bottrell M, Shugarman LR, Galegher J, Bikson T. The health insurance portability and accountability act privacy rule a practical guide for researchers. *Medical Care*. 2004;**42**(4):321–7.
- **123** Gostin LO. National health information privacy: regulations under the health insurance portability and accountability act. *Journal of the American Medical Association*. 2001;**285**(23):3015–21.
- **124** Forgó N. My health data your research: some preliminary thoughts on different values in the General Data Protection Regulation. *International Data Privacy Law.* 2015;**5**(1):54–63.

- **125** McGraw D. Building public trust in uses of Health Insurance Portability and Accountability Act de-identified data. *Journal of the American Medical Informatics Association*. 2013;**20**(1):29–34.
- **126** El Emam K, Jonker E, Arbuckle L, Malin B. A systematic review of re-identification attacks on health data. *PLoS ONE*. 2011;**6**(12):e28071.
- **127** Rothstein MA. Is deidentification sufficient to protect health privacy in research? *American Journal of Bioethics*. 2010;**10**(9):3–11.
- **128** Whitney CW, Lind BK, Wahl PW. Quality assurance and quality control in longitudinal studies. *Epidemiologic Reviews*. 1998;**20**(1):71–80.
- **129** Arts DG, De Keizer NF, Scheffer GJ. Defining and improving data quality in medical registries: a literature review, case study, and generic framework. *Journal of the American Medical Informatics Association*. 2002;**9**(6):600–11.
- 130 World Health Organization. *Improving Data Quality: A Guide for Developing Countries*. World Health Organization, Regional Office for the Western Pacific, 2003.
- **131** Sorensen HT, Sabroe S, Olsen J. A framework for evaluation of secondary data sources for epidemiological research. *International Journal of Epidemiology*. 1996;**25**(2):435–42.
- **132** Hall GC, Sauer B, Bourke A, Brown JS, Reynolds MW, LoCasale R. Guidelines for good database selection and use in pharmacoepidemiology research. *Pharmacoepidemiology and Drug Safety*. 2012;**21**(1):1–10.

- **133** Herrett E, Thomas SL, Schoonen WM, Smeeth L, Hall AJ. Validation and validity of diagnoses in the General Practice Research Database: a systematic review. *British Journal of Clinical Pharmacology*. 2010;**69**(1):4–14.
- 134 Khan NF, Harrison SE, Rose PW. Validity of diagnostic coding within the General Practice Research Database: a systematic review. *British Journal of General Practice*. 2010;60(572):e128–36.
- **135** Heerdink ER, Leufkens HG, Koppedraaijer C, Bakker A. Information on drug use in the elderly: a comparison of pharmacy, general-practitioner and patient data. *Pharmacy World & Science*. 1995;**17**(1):20–4.
- **136** Lau HS, de Boer A, Beuning KS, Porsius A. Validation of pharmacy records in drug exposure assessment. *Journal of Clinical Epidemiology*. 1997;**50**(5):619–25.
- 137 European Medicines Agency. The European Network of Centres for Pharmacoepidemiology and Pharmacovigilance (ENCePP). Guide on Methodological Standards in Pharmacoepidemiology. Available from: http://www.encepp.eu/standards_and_guidances/documents/ENCePPGuideofMethStandardsinPE.pdf (last accessed 18 November 2015).
- 138 US Department of Health and Human Services, Food and Drug Administration. Guidance for Industry and FDA Staff: Best Practices for Conducting and Reporting Pharmacoepidemiologic Safety Studies Using Electronic Healthcare Data. Food and Drug Administration, 2013.

- 1 Dukes MNG, ed. *Drug Utilization Studies: Methods and Uses*. Copenhagen, WHO Regional Office for Europe, 1993. WHO Regional Publications European Series No. 45.
- **2** Engel A, Siderius P. The consumption of drugs. Report on a study, 1966–1967. Copenhagen, WHO Regional Office for Europe, 1968. EURO 3101.
- **3** World Health Organization. *Introduction to Drug Utilization Research*. NLM Classification WB 330. Oslo, World Health Organization, 2003.
- **4** WHO Collaborating Centre for Drug Statistics Methodology for the ATC/DDD Methodology website: www.whocc.no.
- **5** WHO Collaborating Centre for Drug Statistics Methodology. *Guidelines for ATC Classification and DDD Assignment 2014.* Oslo, World Health Organization, 2013.
- **6** WHO Collaborating Centre for Drug Statistics Methodology. *ATC Classification Index with DDDs 2014*. Oslo, World Health Organization, 2013.
- 7 Euro-Med-Stat: Working Group on Recommendations for National Registers of Medicinal Products with validated ATC codes and DDD values, final version March 2004. Available from: http://ec.europa.eu/health/ph_projects/2001/monitoring/fp_monitoring_2001_frep_12_1_en.pdf (last accessed 18 November 2015).
- **8** Rønning M, Blix HS, Strøm H, Skovlund E, Anderson M, Vander Stichele R. Problems in collecting comparable national drug use data in Europe: the example of antibacterials. European *Journal of Clinical Pharmacology.* 2003;**58**:843–9.
- **9** Rønning M, Blix HS, Harbø BT, Strøm H. Different versions of the anatomical therapeutic chemical classification system and the defined daily dose are

- drug utilization data comparable? *European Journal of Clinical Pharmacology*. 2000;**56**:723–7.
- 10 WHO Collaborating Centre for Drug Statistics Methodology. *Guidelines for ATC Vet Classification 2014*. Oslo, World Health Organization, 2013.
- **11** WHO Collaborating Centre for Drug Statistics Methodology. *ATC Vet Index 2014*. Oslo, World Health Organization, 2013.
- **12** WHO Collaborating Centre for Drug Statistics Methodology for the ATCvet Classification website: www. whocc.no/atcvet.
- 13 European Medicines Agency. Trends in the Sales of Veterinary Antimicrobial Agents in Nine European Countries (2005–2009). EMA/238630/2011.
- **14** Comparison of the WHO ATC classification & E*ph*MRA/PBIRG anatomical classification: version January 2013. Available from: http://www.ephmra.org/user_uploads/who-atc%202013%20final.pdf (last accessed 18 November 2015).
- **15** EphMRA Anatomical Classification website: www. ephmra.org/Anatomical-Classification.
- **16** American Society of Health-System Pharmacists. *AHFS Drug Information 2014.* Bethesda, MD, American Society of Health-System Pharmacists, 2014.
- 17 AHFS Pharmacologic-Therapeutic Classification website: www.ahfsdruginformation.com/pt-classification-system.aspx.
- 18 British National Formulary: www.bnf.org.
- 19 NHS Prescription Services. BNF Classification and Pseudo Classification Used by NHS Prescription Services. Newcastle upon Tyne, NHS Business Services Authority, 2012. Available from: http://www.nhsbsa.nhs.uk/PrescriptionServices/Documents/PrescriptionServices/BNF_Classification_Booklet-2012.pdf (last accessed 18 November 2015).
- **20** Prescribing Data (Presentation Level) by GP Practice: Glossary of Terms. Leeds, Health and Social

- Care Information Centre, 2012. Available from: http://www.hscic.gov.uk/CHttpHandler.ashx?id=10686&p=0 (last accessed 18 November 2015).
- 21 WHO Website for the International Nonproprietary Names (INN) Programme: http://www.who.int/medicines/services/inn/en/ (last accessed 18 November 2015).
- 22 American Medical Association. United States Adopted Names. Available from: http://www.ama-assn.org/ama/pub/physician-resources/medical-science/united-states-adopted-names-council.page (last accessed 18 November 2015).
- **23** British Pharmacopoeia. British Approved Names. Available from: http://www.pharmacopoeia.co.uk/2014/ban.htm (last accessed 18 November 2015).
- **24** WHO website for International Classification of Diseases (ICD): http://www.who.int/classifications/icd/en/ (last accessed 18 November 2015).

- **25** WHO website for International Classification of Diseases (ICD), 11th revision: http://www.who.int/classifications/icd/revision/icd11faq/en/index.html (last accessed 18 November 2015).
- 26 NIH US National Library of Medicine. Unified Medical Language System (UMLS), SNOMED Clinical Terms. Available at: http://www.nlm.nih.gov/research/umls/Snomed/snomed_main.html (last accessed 18 November 2015).
- 27 International Health Terminology Standards Development Organisation, SNOMED CT. Available from: http://www.ihtsdo.org/snomed-ct (last accessed 18 November 2015).
- **28** Terminology Service. User's Guide to Read Codes and the Read Code Browser. Edinburgh, NHS National Services Scotland, 2012.

- 1 WHO Collaborating Centres for Drug Statistics Methodology. *Guidelines for ATC Classification and DDD Assignment 2014*. Oslo, World Health Organization, 2013
- **2** WHO Collaborating Centre website: www.whocc.no.
- **3** Rønning M, Blix HS, Strøm H, Skovlund E, Andersen M, Stichele RV. Problems in collecting comparable national drug use data in Europe: the example of antibacterials. *European Journal of Clinical Pharmacology*. 2003;**58**(12):843–9.
- **4** Teng L, Xin HW, Blix HS, Tsutani K. Review of the use of defined daily dose concept in drug utilisation research in China. *Pharmacoepidemiology and Drug Safety*. 2012;**21**(10):1118–24.
- **5** Rønning M, Blix HS, Harbø BT, Strøm H. Different versions of the anatomical therapeutic chemical classification system and the defined daily dose are drug utilisation data comparable? *European Journal of Clinical Pharmacology*. 2000;**56**(9–10):723–7.
- **6** Coenen S, Gielen B, Blommaert A, Beutels P, Hens N, Goossens H. Appropriate international measures for outpatient antibiotic prescribing and consumption: recommendations from a national data comparison of different measures. *Journal of Antimicrobial Chemotherapy*. 2014;**69**(2):529–34.
- **7** Wessling A, Boëthius G. Measurement of drug use in a defined population. Evaluation of the defined daily dose (DDD) methodology. *European Journal of Clinical Pharmacology*. 1990;**39**(3):207–10.
- **8** Merlo J, Wessling A, Melander A. Comparison of dose standard units for drug utilisation studies. *European Journal of Clinical Pharmacology*. 1996;**50**(1–2):27–30.
- **9** Walley T, Roberts D. Average daily quantities: a tool for measuring prescribing volume in England. *Pharmacoepidemiology and Drug Safety*. 2000;**9**(1):55–8.

- 10 Nosè M, Tansella M, Thornicroft G, Schene A, Becker T, Veronese A, et al. Is the Defined Daily Dose system a reliable tool for standardizing antipsychotic dosages? *International Clinical Psychophar*macology. 2008;23(5):287–90.
- 11 Mandy B, Koutny E, Cornette C, Woronoff-Lemsi MC, Talon D. Methodological validation of monitoring indicators of antibiotics use in hospitals. *Pharmacy World & Science*. 2004;**26**(2):90–5.
- **12** Polk RE, Fox C, Mahoney A, Letcavage J, MacDougall C. Measurement of adult antibacterial drug use in 130 US hospitals: comparison of defined daily dose and days of therapy. *Clinical Infectious Diseases*. 2007;**44**(5):664–70.
- **13** Grimmsmann T, Himmel W. Discrepancies between prescribed and defined daily doses: a matter of patients or drug classes? *European Journal of Clinical Pharmacology.* 2011;**67**(8):847–54
- 14 de With K, Bestehorn H, Steib-Bauert M, Kern WV. Comparison of defined versus recommended versus prescribed daily doses for measuring hospital antibiotic consumption. *Infection*. 2009;37(4):349–52.
- **15** Haug JB, Reikvam Å. WHO defined daily doses versus hospital-adjusted defined daily doses: impact on results of antibiotic use surveillance. *Journal of Antimicrobial Chemotherapy*. 2013;**68**(12):2940–7.
- 16 Muller A, Monnet DL, Talon D, Hénon T, Bertrand X. Discrepancies between prescribed daily doses and WHO defined daily doses of antibacterials at a university hospital. *British Journal of Clinical Pharmacology*. 2006;61(5):585–91.
- 17 Valcourt K, Norozian F, Lee H, Raszynski A, Torbati D, Totapally BR. Drug use density in critically ill children and newborns: analysis of various methodologies. *Pediatric Critical Care Medicine*. 2009;10(4):495–9.
- **18** Bronzwaer SL, Cars O, Buchholz U, Mölstad S, Goettsch W, Veldhuijzen IK, et al.; European Anti-

- microbial Resistance Surveillance System. A European study on the relationship between antimicrobial use and antimicrobial resistance. *Emerging Infectious Diseases*. 2002;**8**(3):278–82.
- **19** Bitter I, Chou JC, Ungvari GS, Tang WK, Xiang Z, Iwanami A, Gaszner P. Prescribing for inpatients with schizophrenia: an international multi-center comparative study. *Pharmacopsychiatry*. 2003;**36**(4):143–9.
- **20** Bogle SM, Harris CM. Measuring prescribing: the shortcomings of the item. *British Medical Journal*. 1994;**308**(6929):637–40.
- 21 Folkhälsomyndigheten. Antibiotika och antibiotikaresistens: antibiotika är en grupp läkemedel som används för att behandla bakteriella infektioner. Available from: http://folkhalsomyndigheten. se/amnesomraden/smittskydd-och-sjukdomar/antibiotika-och-antibiotikaresistens/ (last accessed 18 November 2015).
- **22** Castensson S, Eriksson V, Lindborg K, Wettermark B. A method to include the environmental hazard in drug prescribing. *Pharmacy World & Science*. 2009;**31**(1):24–31.
- 23 Simonsen GS, Urdahl AM, eds. NORM/NORM-VET 2012. Usage of Antimicrobial Agents and Occurrence of Antimicrobial Resistance in Norway. Norwegian Veterinary Institute. Available from: http://www.vetinst.no/Publikasjoner/NORM-NORM-VET/NORM-NORM-VET-2012 (lastaccessed 18 November 2015).
- **24** One Health Initiative website: www.onehealthinitiative .com.
- 25 Korsgaard H, Høg BB, Agersø Y, eds. DANMAP 2012. Use of antimicrobial agents and occurrence of antimicrobial resistance in bacteria from food animals, food and humans in Denmark. Available from: http://www.danmap.org/Downloads/~/media/Projekt%20sites/Danmap/DANMAP%20 reports/DANMAP%202012/Danmap_2012.ashx (last accessed 18 November 2015).
- 26 European Medicines Agency. European Surveillance of Veterinary Antimicrobial Consumption (ESVAC). Available from: http://www.ema.europa.eu/ema/index.jsp?curl=pages/regulation/document_listing/document_listing_000302.jsp (last accessed 18 November 2015).
- **27** Sabuncu E, David J, Bernède-Bauduin C, Pépin S, Leroy M, Boëlle PY, et al. Significant reduction of

- antibiotic use in the community after a nation-wide campaign in France, 2002–2007. *PLoS Med.* 2009;**6**(6):e1000084.
- **28** Jin XM, Lee J, Choi NK, Seong JM, Shin JY, Kim YJ, et al. Utilization patterns of disease-modifying antirheumatic drugs in elderly rheumatoid arthritis patients. *Journal of Korean Medical Science*. 2014;**29**(2):210–16.
- 29 Ubeda A, Cardo E, Sellés N, Broseta R, Trillo JL, Fernández-Llimós F. Antidepressant utilization in primary care in a Spanish region: impact of generic and reference-based pricing policy (2000–2004). *Social Psychiatry and Psychiatric Epidemiology*. 2007;42(3):181–8.
- **30** Damiani G, Federico B, Anselmi A, Bianchi CB, Silvestrini G, Iodice L, et al. The impact of regional co-payment and national reimbursement criteria on statins use in Italy: an interrupted time-series analysis. *BMC Health Service Research*. 2014;**14**:6.
- **31** Duong M, Salvo F, Pariente A, Abouelfath A, Lassalle R, Droz C, et al. Usage patterns of 'overthe-counter' vs. prescription-strength nonsteroidal anti-inflammatory drugs in France. *British Journal of Clinical Pharmacology.* **2014**;**77**(5):887–95.
- **32** Ghanname I, Ahid S, Berrada G, Belaiche A, Hassar M, Cherrah Y. Trends in the use of antiasthmatic medications in Morocco (1999–2010). *Springerplus*. 2013;**2**(1):82.
- **33** Rahimtoola H, Egberts AC, Buurma H, Tijssen CC, Leufkens HG. Patterns of ergotamine and sumatriptan use in the Netherlands from 1991 to 1997. *Cephalalgia*. 2001;**21**(5):596–603.
- **34** Cooke C, Nissen L, Sketris I, Tett SE. Quantifying the use of the statin antilipemic drugs: comparisons and contrasts between Nova Scotia, Canada, and Queensland, Australia. *Clinical Therapy*. 2005;**27**(4):497–508.
- **35** Kalo Z, Abonyi-Toth Z, Bartfai Z, Voko Z. Pitfalls associated with the therapeutic reference pricing practice of asthma medication. *BMC Pulmonary Medicine*. 2012;**12**:35.
- **36** Wirtz VJ, Mol PG, Verdijk J, Vander Stichele RH, Taxis K. Use of antibacterial fixed-dose combinations in the private sector in eight Latin American Countries between 1999 and 2009. *Tropical Medicine & International Health.* 2013;**18**(4):416–25.
- 37 Plet HT, Hallas J, Kjeldsen LJ. Adherence to hospital drug formularies and cost of drugs in hospitals in

- Denmark. European Journal of Clinical Pharmacology. 2013;69(10):1837–43.
- Kuster SP, Ruef C, Ledergerber B, Hintermann A, Deplazes C, Neuber L, Weber R. Quantitative antibiotic use in hospitals: comparison of measurements, literature review, and recommendations for a standard of reporting. *Infection*. 2008;**36**(6):549–59.
- Stolker JJ, Heerdink ER, Pullen SE, Santman FW, Hekster YA, Leufkens HG, Zitman FG. Determinants of psychotropic drug usage in a general intensive care unit. *General Hospital Psychiatry*. 1998;**20**(6):371–76.
- Grau S, Fondevilla E, Mojal S, Palomar M, Vallès J, Gudiol F; VINCat Antimicrobial Group. Antibiotic consumption at 46 VINCat hospitals from 2007 to 2009, stratified by hospital size and clinical services. Enfermedades Infecciosas y Microbiología Clínica. 2012;**30**(Suppl. 3):43–51.
- Liew YX, Krishnan P, Yeo CL, Tan TY, Lee SY, Lim WP, et al.; Network for Antimicrobial Resistance Surveillance Singapore. Surveillance of broad-spectrum antibiotic prescription in Singaporean hospitals: a 5-year longitudinal study. PLoS ONE. 2011;**6**(12):e28751.
- Zarb P, Ansari F, Muller A, Vankerckhoven V, Davey PG, Goossens H. Drug utilization 75% (DU75%) in 17 European hospitals (2000–2005): results from the ESAC-2 Hospital Care Sub Project. *Current Clinical Pharmacology*. 2011;**6**(1):62–70.
- Kuster SP, Ruef C, Bollinger AK, Ledergerber B, Hintermann A, Deplazes C, et al. Correlation between case mix index and antibiotic use in hospitals. *Journal of Antimicrobial Chemotherapy*. 2008;**62**(4):837–42.
- Polk RE, Hohmann SF, Medvedev S, Ibrahim O. Benchmarking risk-adjusted adult antibacterial drug use in 70 US academic medical center hospitals. *Clinical Infectious Diseases*. 2011;**53**(11):1100–10.
- AMC Tool: the antimicrobial consumption tool. Available from: http://amu-tools.org/amctool/amctool.html (last accessed 18 November 2015).
- European Centre for Disease Prevention and Control. European Surveillance of Antimicrobial Consumption Network (ESAC-Net). Available from: http://www.ecdc.europa.eu/en/activities/surveillance/esac-net/pages/index.aspx (18 November 2015).

- Filius PM, Liem TB, van der Linden PD, Janknegt R, Natsch S, Vulto AG, Verbrugh HA. An additional measure for quantifying antibiotic use in hospitals. *Journal of Antimicrobial Chemotherapy*. 2005:**55**(5):805–8.
- Blix HS, Røed J, Sti MO. Large variation in antibacterial use among Norwegian nursing homes. *Scandinavian Journal of Infectious Diseases*. 2007;**39**(6–7):536–41.
- Pittrow D, Krappweis J, Rentsch A, Schindler C, Hach I, Bramlage P, Kirch W. Pattern of prescriptions issued by nursing home-based physicians versus office-based physicians for frail elderly patients in German nursing homes. *Pharmacoepidemiological Drug Safety.* 2003;**12**(7):595–9.
- Nhachi CF, Zvaraya P, Kasilo J. Drug utilisation in the geriatric population in the nursing homes and central hospitals of urban Harare. *Central African Journal of Medicine*. 1994;**40**(5):126–31.
- **51** Eriksen HM, Sæther AR, Viktil KK, Andberg L, Munkerud MW, Willoch K, Blix HS. Use of antibiotics in nursing homes surveillance with different methods. *Tidsskrift for den Norske laegeforening*. 2013;**133**(19):2052–6.
- **52** Majic T, Pluta JP, Mell T, Aichberger MC, Treusch Y, Gutzmann H, et al. The pharmacotherapy of neuropsychiatric symptoms of dementia: a cross-sectional study in 18 homes for the elderly in Berlin. *Deutsches Ärzteblatt International*. 2010;**107**(18):320–7.
- 53 Sicras-Mainar A, Peláez-de-Loño J, Castellá-Rosales A, Rodríguez-Darriba M. Consumption of inappropriate psychotropic drugs in residential homes for the elderly: comparative study between 2001 and 2006. Farmacia Hospitalaria. 2008;32(2):96–101.
- Irwin A, Sharland M. Measuring antibiotic prescribing in hospitalised children in resource-poor countries: a systematic review. *Journal of Paediatric Child Health*. 2013;**49**(3):185–92.
- **55** Porta A, Hsia Y, Doerholt K, Spyridis N, Bielicki J, Menson E, et al. Comparing neonatal and paediatric antibiotic prescribing between hospitals: a new algorithm to help international benchmarking. *Journal of Antimicrobial Chemotherapy*. 2012;**67**(5):1278–86.

- **1** Lassen A, Hallas J, Schaffalitzky De Muckadell OB. Use of anti-secretory medication: a population-based cohort study. Alimentary Pharmacology & Therapeutics. 2004;**20**(5):577–83.
- **2** WHO Collaborating Centre for Drug Statistics Methodology website: www.whocc.no.
- 3 MedStat website: www.medstat.dk.
- **4** Van Staa TP, Abenhaim L, Leufkens H. A study of the effects of exposure misclassification due to the time-window design in pharmacoepide-miologic studies. *Journal of Clinical Epidemiology*. 1994;**47**(2):183–9.
- **5** Bjerrum L, Rosholm JU, Hallas J, Kragstrup J. Methods for estimating the occurrence of polypharmacy by means of a prescription database. *European Journal of Clinical Pharmacology*. 1997;**53**(1):7–11.
- **6** Pottegård A, Zoëga H, Hallas J, Damkier P. Use of SSRIs among Danish children: a nationwide study. *European Child and Adolescent Psychiatry*. 2014;**23**(12):1211–18.
- **7** Gardarsdottir H, Souverein PC, Egberts TCG, Heerdink ER. Construction of drug treatment episodes from drug-dispensing histories is influenced by the gap length. *Journal of Clinical Epidemiology*. 2010;**63**(4):422–7.
- **8** Nielsen LH, Løkkegaard E, Andreasen AH, Keiding N. Using prescription registries to define continuous drug use: how to fill gaps between prescriptions. *Pharmacoepidemiology and Drug Safety*. 2008;**17**(4):384–8.
- **9** Suissa S. Immortal time bias in pharmacoepidemiology. *American Journal of Epidemiology*. 2008;**167**(4):492–9.
- 10 Pottegård A, Hallas J. Assigning exposure duration to single prescriptions by use of the waiting time

- distribution. *Pharmacoepidemiology and Drug Safety*. 2013;**22**(8):803–9.
- **11** Hallas J, Støvring H. Templates for analysis of individual-level prescription data. *Basic Clinical Pharmacology and Toxicology*. 2006;**98**(3):260–5.
- 12 Gardarsdottir H, Heerdink ER, Egberts ACG. Potential bias in pharmacoepidemiological studies due to the length of the drug free period: a study on antidepressant drug use in adults in the Netherlands. *Pharmacoepidemiology and Drug Safety*. 2006;15(5):338–43.
- **13** Rothman KJ. *Epidemiology: An Introduction*. Oxford, Oxford University Press, 2002.
- **14** Shah ND, Dunlay SM, Ting HH, Montori VM, Thomas RJ, Wagie AE, et al. Long-term medication adherence after myocardial infarction: experience of a community. *Am J Med.* 2009; 122: 961.e7–13.
- **15** Benner JS, Glynn RJ, Mogun H, Neumann PJ, Weinstein MC, Avorn J. Long-term persistence in use of statin therapy in elderly patients. *Journal of the American Medical Association*. 2002;**288**(4):455–61.
- 16 Østergaard K, Hallas J, Bak S, Christensen Rd, Gaist D. Long-term use of antiplatelet drugs by stroke patients: a follow-up study based on prescription register data. *European Journal of Clinical Pharmacol*ogy. 2012;68(12):1631–7.
- **17** Alho JM. On prevalence, incidence, and duration in general stable populations. *Biometrics*. 1992;**48**(2):587–92.
- **18** Suissa S, Spitzer WO, Abenhaim L, Downey W, Gardiner RJ, Fitzgerald D. Risk of death from human insulin. *Pharmacoepidemiology and Drug Safety*. 1992;**1**:169–75.
- **19** Haffner SM, Lehto S, Rönnemaa T, Pyörälä K, Laakso M. Mortality from coronary heart disease in subjects with type 2 diabetes and in nondiabetic subjects with and without prior myocardial infarction. *New England Journal of Medicine*. 1998;**339**(4):229–34.

- Støvring H, Andersen M, Beck-Nielsen H, Green A, Vach W. Rising prevalence of diabetes: evidence from a Danish pharmaco-epidemiological database. *Lancet.* 2003;**362**(9383):537–8.
- Nielsen LH, Løkkegaard E, Andreasen AH, Hundrup YA, Keiding N. Estimating the effect of current, previous and never use of drugs in studies based on prescription registries. *Pharmacoepidemiology and Drug Safety.* 2009;**18**(2):147–53.
- **22** Rosholm JU, Gram LF, Isacsson G, Hallas J, Bergman U. Changes in the pattern of antidepressant use upon the introduction of the new antidepressants: a prescription database study. *European Journal of Clinical Pharmacology*. 1997;**52**(3):205–9.
- Brostrøm S, Hallas J. Persistence of antimuscarinic drug use. *European Journal of Clinical Pharmacology*. 2009;**65**(3):309–14.
- Pottegård A, Poulsen BK, Larsen MD, Hallas J. Dynamics of vitamin K-antagonist and new oral anticoagulants use in atrial fibrillation: a Danish drug utilization study. *Journal of Thrombosis and Haemostasis*. 2014;**12**(9):1413–18.
- 25 Arnlind MH, Wettermark B, Nokela M, Hjemdahl P, Rehnberg C, Jonsson EW. Regional variation and adherence to guidelines for drug treatment of asthma. *European Journal of Clinical Pharmacology*. 2010;66(2):187–98.
- Hallas J, Gaist D, Bjerrum L. The waiting time distribution as a graphical approach to epidemiologic measures of drug utilization. *Epidemiology*. 1997;**8**:666–70.
- **27** Støvring H, Vach W. Estimation of prevalence and incidence based on occurrence of health-related events. *Statistics in Medicine*. 2005;**24**(20):3139–54.
- Støvring H. Selection bias due to immigration in pharmacoepidemiologic studies. *Pharmacoepidemiology and Drug Safety*. 2007;**16**(6):681–6.

- Støvring H, Andersen M, Beck-Nielsen H, Green A, Vach W. Counting drugs to understand the disease: the case of measuring the diabetes epidemic. *Population Health Metrics*. 2007;**5**:2.
- Gaist D, Hallas J, Sindrup SH, Gram LF. Is overuse of sumatriptan a problem? A population-based study. *European Journal of Clinical Pharmacology*. 1996;**50**(3):161–5.
- 31 Furu K, Wettermark B, Andersen M, Martikainen JE, Almarsdottir AB, Sørensen HT. The Nordic countries as a cohort for pharmacoepidemiological research. *Basic Clinical Pharmacology and Toxicology*. 2010;106(2):86–94.
- World Health Organization. Introduction to drug utilization research. Oslo, World Health Organization, 2003.
- Pottegård A, Bjerregaard BK, Larsen MD, Larsen KS, Hallas J, Knop FK, et al. Use of exenatide and liraglutide in Denmark: a drug utilization study. *European Journal of Clinical Pharmacology*. 2014;**70**(2):205–14.
- Pottegård A, Bjerregaard BK, Glintborg D, Kortegaard LS, Hallas J, Moreno SI. The use of medication against attention deficit/hyperactivity disorder in Denmark: a drug use study from a patient perspective. *European Journal of Clinical Pharmacology*. 2013;**69**(3):589–98.
- Hennessy S, Freeman CP, Cunningham F. US Government Claims Databases. In: Strom BL, Kimmel SE, eds. *Pharmacoepidemiology*, 5th edn. Chichester, John Wiley & Sons, 2012.
- **36** Pottegård A, Bjerregaard BK, Glintborg D, Hallas J, Moreno SI. The use of medication against attention deficit hyperactivity disorder in Denmark: a drug use study from a national perspective. *European Journal of Clinical Pharmacology*. 2012;**68**(10): 1443–50.

- 1 Lu Y, Hernandez P, Abegunde D, Edejer T. *The World Medicines Situation 2011. Medicine Expenditures.* Geneva, World Health Organization, 2011.
- 2 Organisation for Economic Co-operation and Development Health Data. Available from: http://stats.oecd.org/index.aspx?DataSetCode=HEALTH_STAT (last accessed 18 November 2015).
- **3** Eurostat Health Database. Available from: http://ec.europa.eu/eurostat/web/health/health-care/data/database (last accessed 18 November 2015).
- **4** Organisation for Economic Co-operation and Development. Joint OECD-EUROSTAT-WHO Health Accounts Data-Collection Initiative Launched. *OECD Health Update*. 2006;**2**.
- **5** van Mosseveld C. EUROSTAT's activities in the area of health system comparisons. *European Journal of Public Health*. 2007;66–.
- **6** OECD, Eurostat and WHO. A System of Health Accounts. Paris, OECD, 2011.
- **7** OECD. Health at a Glance 2013: OECD Indicators. Paris, OECD, 2013.
- **8** OECD. OECD Glossary of Statistical Terms. Paris, OECD, 2008.
- **9** Vogler S, Habl C, Leopold C, Mazag J, Morak S, Zimmermann N. PHIS Hospital Pharma Report. Vienna, Pharmaceutical Health Information System (PHIS); commissioned by the European Commission and the Austran Federal Ministry of Health, 2010.
- 10 WHO Collaborating Centre for Pharmaceutical Pricing and Reimbursement Policies. Glossary of pharmaceutical terms. Update 2013. Vienna 2013.
- 11 OECD. Pharmaceutical Pricing Policies in a Global Market. *OECD Health Policy Studies*. Paris, OECD, 2008.
- **12** Vogler S, Habl C, Bogut M, Voncina L. Comparing pharmaceutical pricing and reimbursement policies

- in Croatia to the European Union Member States. *Croatian Medical Journal*. 2011;**52**:197.
- 13 Vogler S, Habl C, Leopold C, Rosian-Schikuta I, de Joncheere K, Lyager Thomsen T. PPRI Report. Vienna, Pharmaceutical Pricing and Reimbursement Information, 2008.
- 14 PPRI Network Members. PPRI/PHIS Posters country specific reports on different issues related to pharmaceutical systems and policies. *Pharmaceutical Pricing and Reimbursement Information (PPRI)/Pharmaceutical Health Information System (PHIS)*. Vienna, 2007–2013. Available from: http://whocc.goeg.at/Publications/CountryPosters (last accessed 18 November 2015).
- 15 PPRINetwork Members. PPRI/PHIS Pharma Profiles—country specific reports on pharmaceutical systems and policies. *Pharmaceutical Pricing and Reimbursement Information (PPRI) / Pharmaceutical Health Information System (PHIS)*. Vienna, 2007–2013. Available from: http://whocc.goeg.at/Publications/CountryReports (last accessed 18 November 2015).
- **16** Leopold C, Vogler S, Mantel-Teeuwisse AK, de Joncheere K, Leufkens HG, Laing R. Differences in external price referencing in Europe a descriptive overview. *Health Policy*. 2012;**104**:50–60.
- 17 Leopold C, Mantel-Teeuwisse AK, Seyfang L, Vogler S, de Joncheere K, Laing RO, Leufkens H. Impact of external price referencing on medicine prices a price comparison among 14 European countries. *Southern Med Review.* 2012;**5**(2):34–41.
- 18 PPRI Secretariat. Pharmaceutical policy monitoring exercise with national competent authorities represented in the PPRI network (unpublished). Bi-annually, latest update: September 2014. Pharmaceutical Pricing and Reimbursement Information (PPRI), 2014.
- **19** Vogler S. How large are the differences between originator and generic prices? Analysis of five molecules

- in 16 European countries. *Farmeconomia Health Economics and Therapeutic Pathways*. 2012;**13**:29–41.
- **20** Kanavos P, Vandoros S, Irwin R, Nicod E, Casson M. *Differences in Costs Of and Access To Pharmaceutical Products in the EU*. Brussels, European Parliament, 2011.
- 21 Vogler S. The impact of pharmaceutical pricing and reimbursement policies on generics uptake: implementation of policy options on generics in 29 European countries an overview. *Generics and Biosimilars Initiative (GaBI) Journal*. 2012;1:93–100.
- 22 PHIS database: https://phis.goeg.at/index.aspx?_ nav0029.
- 23 Kanavos P, Schurer W, Vogler S. Pharmaceutical Distribution Chain in the European Union: Structure and Impact on Pharmaceutical Prices. London/ Vienna, EMINet/LSE/GÖG, 2011.
- 24 Vogler S, Pertl D, Schmickl B, Windisch F. Apothekenhonorierung in Europa [Pharmacy remuneration in Europe]. Vienna, Gesundheit Österreich Forschungs- und Planungsgesellschaft mbH, 2014.
- **25** Vogler S. Preisbildung und Erstattung von Arzneimitteln in der EU Gemeinsamkeiten, Unterschiede und Trends. *Pharmazeutische Medizin*. 2012;**14**:56.
- **26** Cameron A, Ewen M, Ross-Degnan D, Ball D, Laing R. Medicine prices, availability, and affordability in 36 developing and middle-income countries: a secondary analysis. *Lancet*. 2009;**373**:240–9.
- 27 Ball D. Working Paper 3: Regulation of Mark-Ups in the Pharmaceutical Supply Chain Review Series on Pharmaceutical Pricing Policies and Interventions. Geneva, World Health Organization and Health Action International, 2011.
- **28** Levison L, Laing R. The hidden costs of essential medicines. *Essential Drugs Monitor*. 2003;**33**:20–1.
- **29** WHO Collaborating Centre for Pharmaceutical Pricing and Reimbursement Policies. Glossary of pharmaceutical terms. Latest update of print version: 2011; regularly updated online. Vienna, World Health Organization, 2011.
- **30** Godman B, Bennie M, Baumgärtel C, et al. Essential to increase the use of generics in Europe to maintain comprehensive health care? *Farmeconomia Health Economics and Therapeutic Pathways*. 2012;**13**:5–20.
- 31 Habl C, Vogler S, Leopold C, Schmickl B, Fröschl B. Referenzpreissysteme in Europa. Analyse und Umsetzungsvoraussetzungen für Österreich. Vienna: ÖBIG Forschungs- und Planungsgesellschaft mbH, 2008.

- 32 Kanavos P, Seeley L, Vandoros S. Tender systems for outpatient pharmaceuticals in the European Union: evidence from the Netherlands, Germany and Belgium. European Medicines Information Network (EMINet), 2009.
- **33** Lopes S, Marty C, Berdai D. PHIS Pharma Profile France. Vienna, Pharmaceutical Health Information System (PHIS), 2011.
- **34** Vogler S, Zimmermann N, Habl C, Piessnegger J, Bucsics A. Discounts and rebates granted to public payers for medicines in European countries. *Southern Med Review.* 2012;**5**:38–46.
- 35 Espín J, Rovira J, García L. Experiences and Impact of European Risk-Sharing Schemes Focusing on Oncology Medicines. EMINet, 2011.
- **36** Adamski J, Godman B, Ofierska-Sujkowska G, Osińska B, Herholz H, Wendykowska K, et al. Risk sharing arrangements for pharmaceuticals: potential considerations and recommendations for European payers. *BMC Health Services Research*. 2010;**10**:153.
- **37** Vogler S, Zimmermann N, Mazag J. Procuring medicines in hospitals: results of the European PHIS survey. *EJHP Practice*. 2011:20–1.
- 38 Vogler S, Zimmermann N, Leopold C, Habl C, Mazag J. Discounts and rebates granted for medicines for hospital use in five European countries. *Open Pharmacoeconomics & Health Economics Journal* 2013;5:1−10
- 39 Council Directive 89/105/EEC of 21 December 1988 relating to the transparency of measures regulating the pricing of medicinal products for human use and their inclusion in the scope of national health insurance systems.
- **40** Espin J, Rovira J, de Labry AO. Working Paper 1: External Price Referencing Review Series on Pharmaceutical Pricing Policies and Interventions. Geneva, World Health Organization and Health Action International, 2011.
- **41** Gesundheit Österreich GmbH (Austrian Health Institute). Pharma Price Information (PPI) service. Available from: http://www.goeg.at/en/PPI (last accessed 18 November 2015).
- **42** Bouvy J, Vogler S. Background paper 8.3. Pricing and reimbursement policies: impacts on innovation. In: World Health Organization. *Priority Medicines for Europe and the World 'A Public Health Approach to Innovation' Update on 2004 Background Paper*. Geneva, World Health Organization, 2013.

- **43** World Health Organization and Health Action International (HAI). *Medicine Prices: A New Approach to Measurement. Working Draft for Field Testing and Revision.* Geneva, World Health Organization, 2003.
- **44** World Health Organization and Health Action International. *Measuring Medicine Prices, Availability, Affordability and Price Components,* 2nd edn. Geneva, World Health Organization, 2008.
- **45** European Pharmaceutical Marketing Research Association (EphMRA). EphMRA Lexicon: A Pocket Guide to Pharmaceutical Marketing and Marketing Research Terms and Definitions.
- **46** WHO Collaborating Centre for Drug Statistics Methodology. Use of ATC/DDD. Available from: http://www.whocc.no/use_of_atc_ddd/ (last accessed 18 November 2015).
- **47** Danzon PM, Kim JD. International price comparisons for pharmaceuticals. *Pharmacoeconomics*. 1998;**14**:115–28.
- **48** Hill P. International price levels and purchasing power parities. *OECD Economic Studies*. 1986;**6**:133–59.
- **49** Danzon PM, Furukawa MF. Prices and availability of pharmaceuticals: evidence from nine countries. *Health Affairs*. 2003:W3-521.
- **50** Danzon PM, Furukawa MF. International prices and availability of pharmaceuticals in 2005. *Health Affairs*. 2008;**27**:221–33.

- **51** Kanavos PG, Vandoros S. Determinants of branded prescription medicine prices in OECD countries. *Health Economics Policy and Law.* 2011;**6**:337.
- **52** Kanavos P, Ferrario A, Vandoros S, Anderson GF. Higher US branded drug prices and spending compared to other countries may stem partly from quick uptake of new drugs. *Health Affairs*. 2013;**32**:753–61.
- **53** Brekke KR, Holmås TH, Straume OR. Are Pharmaceuticals Still Inexpensive in Norway? A Comparison of Prescription Drug Prices in Ten European Countries. SNF Report No. 08/10. 2010.
- 54 Paris V, Belloni A. Value in Pharmaceutical Pricing. OECD Health Working Papers, No. 63. Paris, OECD, 2013.
- 55 von der Schulenburg F, Vandoros S, Kanavos P. The effects of drug market regulation on pharmaceutical prices in Europe: overview and evidence from the market of ACE inhibitors. *Health Economics Review*. 2011:1:1–8.
- **56** Simoens S. International comparison of generic medicine prices. *Current Medical Research and Opinion*. 2007;**23**:2647–54.
- **57** Tafuri G, Creese A, Reggi V. National and international differences in the prices of branded and unbranded medicines. *Journal of Generic Medicines*. 2004;1:120–7.

- 1 Dawson B, Trapp RG. *Basic & Clinical Biostatistics*, 4th edn. New York, Medical Books/Mc Graw-Hill, 2004.
- **2** Yang Y, West-Strum D. *Understanding Pharmacoepide-miology*. New York, McGraw-Hill Medical, 2011.
- 3 Kirkwood BR, Sterne J. Essential Medical Statistics, 2nd edn. Malden, MA, Blackwell Science, 2003.
- **4** Bowers D. *Medical Statistics from Scratch*, 2nd edn. Chichester, John Wiley & Sons, 2008.
- **5** Whitley E, Ball J. Statistics review 2: samples and populations. *Critical Care*. 2002;**6**(2):143–8.
- **6** Whitley E, Ball J. Statistics review 4: sample size calculations. *Critical Care*. 2002. **6**(4):335–41.
- **7** Sedgwick P. Confidence intervals: predicting uncertainty. *British Medical Journal*. 2012:344.
- **8** Kalinowski P. Understanding confidence intervals (CIs) and effect size estimation. *Observer.* 2010:23.
- **9** Whitley E, Ball J. Statistics review 1: presenting and summarising data. *Critical Care*. 2002;**6**(1):66–71.
- **10** Kier KL. Biostatistical applications in epidemiology. *Pharmacotherapy*. 2011;**31**(1):9–22.
- **11** Whitley E, Ball J. Statistics review 3: hypothesis testing and P values. *Critical Care*. 2002;**6**(3):222–5.
- **12** Ludbrook J. Should we use one-sided or two-sided P values in tests of significance? *Clinical and Experimental Pharmacology and Physiology.* 2013;**40**(6):357–61.

- **13** Lew MJ. Bad statistical practice in pharmacology (and other basic biomedical disciplines): you probably don't know P. *British Journal of Pharmacology*. 2012;**166**(5):1559–67.
- **14** Bewick V, Cheek L, Ball J. Statistics review 9: one-way analysis of variance. *Critical Care*. 2004;**8**(2):130–6.
- **15** Whitley E, Bai J. Statistics review 6: nonparametric methods. *Critical Care*. 2002;**6**(6):509–13.
- **16** Bewick V, Cheek L, Ball J. Statistics review 11: assessing risk. *Critical Care*. 2004;**8**(4):287–91.
- 17 Bewick V, Cheek L, Ball J. Statistics review 7: correlation and regression. *Critical Care*. 2003;**7**(6):451–9.
- **18** Bewick V, Cheek L, Ball J. Statistics review 14: logistic regression. *Critical Care*. 2005;**9**(1):112–18.
- 19 Wang KY, Seed P, Schofield P, Ibrahim S, Ashworth M. Which practices are high antibiotic prescribers? A cross-sectional analysis. *British Journal of General Practice*. 2009;59(567):724–7.
- **20** Azermai M, Elseviers M, Petrovic M, van Bortel L, Stichele RV. Assessment of antipsychotic prescribing in Belgian nursing homes. *International Psychogeriat- rics.* 2011;**23**(8):1240–8.
- 21 Simpson SH, Eurich DT, Majumdar SR, Padwal RS, Tsuyuki RT, Varney J, Johnson JA. A meta-analysis of the association between adherence to drug therapy and mortality. *British Medical Journal*. 2006;333(7557):15–18.

- 1 Spence R. Information for Visualization. Design for Interaction. London, Pearson Education, 2007.
- **2** Ware C. *Information Visualization. Perception for Design.* Waltham, MA, Morgan Kaufmann, 2013.
- 3 Chen C, Härdle W, Unwin A, eds. *Handbook of Data Visualization*. Berlin, Springer, 2008.
- **4** Kirk A. *Data Visualisation: A Successful Design Process*, 1st edn. Birmingham, Packt Publishing, 2012.
- **5** Treisman A. Preattentive processing in vision. *Computer Vision, Graphics, and Image Processing.* 1985;**31**(2):156–77.
- **6** Cleveland W, McGill R. Graphical perception the visual decoding of quantitative information on graphical displays of data. *Journal of the Royal Statistical Society Series A –Statistics in Society.* 1987;**150**:192–229.
- **7** Cleveland W, McGill R. Graphical perception: theory, experimentation, and application to the development of graphical methods. *Journal of the American Statistical Association*. 1984;**79**:531–54.
- **8** Few S. Eenie, Meenie, Minie, Moe: Selecting the Right Graph for Your Message. Available from: http://www.perceptualedge.com/articles/ie/the_right_graph.pdf (last accessed 18 November 2015).
- **9** Mackinlay J. Automating the design of graphical presentations of relational information. *ACM Transactions on Graphics*. 1986;**5**:110–41.
- **10** Cukier K. A special report on managing information. *Economist.* 2010;**394**(8671):3–18.
- 11 Kelleher C, Wagener T. Ten guidelines for effective data visualization in scientific publications. *Environmental Modelling & Software*. 2011;**26**(6):822–7.
- **12** Tufte E. *The Visual Display of Quantitative Information*, 2nd edn. Graphics Press, 2001.
- **13** Tufte E. Visual Explanations: Images and Quantities, Evidence and Narrative. Graphics Press, 1997.

- **14** Tukey JW. *Exploratory Data Analysis*, 1st edn. Pearson, 1977.
- **15** Lane DM. *Introduction to Statistics*. Available from: http://onlinestatbook.com/Online_Statistics_ Education.pdf (last accessed 18 November 2015).
- **16** Upton G, Cook I, eds. *A Dictionary of Statistics*. New York, Oxford University Press, 2011.
- 17 Streit M, Gehlenborg N. Points of view: bar charts and box plots. *Nature Methods*. 2014;11(2):117.
- **18** Editorial. Kick the bar chart habit. *Nature Methods*. 2014;**11**(2):113.
- **19** Chen H, Boutros PC. VennDiagram: a package for the generation of highly-customizable Venn and Euler diagrams in R. *BMC Bioinformatics*. 2011;**12**:35.
- **20** Shahbaba B. *Biostatistics with R: An Introduction to Statistics through Biological Data (Use R!).* New York, Springer, 2012.
- **21** Berthold R, ed. *Guide to Intelligent Data Analysis: How to Intelligently Make Sense of Real Data.* London, Springer, 2010.
- **22** Spitzer M, Wildenhain J, Rappsilber J, Tyers M. BoxPlotR: a web tool for generation of box plots. *Nat Methods*. 2014;**11**(2):121–2.
- **23** Krzywinski M, Altman N. Points of significance: visualizing samples with box plots. *Nature Methods*. 2014;**11**(2):119–20.
- **24** BoxPlotR: boxplot.tyerslab.com.
- 25 Online analytics and data visualization tool: https:// plot.ly/.
- **26** Bergman U, Popa C, Tomson Y, Wettermark B, Einarson TR, Aberg H, et al. Drug utilization 90% a simple method for assessing the quality of drug prescribing. *European Journal of Clinical Pharmacology*. 1998;**54**(2):113–18.
- **27** Lorenz M. Methods of measuring the concentration of wealth. *Publications of the American Statistical Association*. 1905;**9**:209–19.

- **28** Hallas J, Stovring H. Templates for analysis of individual-level prescription data. *Basic Clinical Pharmacology and Toxicology*. 2006;**98**(3):260–5.
- **29** Malo S, Jose Rabanaque M, Feja C, Jesus Lallana M, Aguilar I, Bjerrum L. High antibiotic consumption: a characterization of heavy users in Spain. *Basic Clinical Pharmacology and Toxicology*. 2014;**115**(3):231–6.
- **30** Benko R, Matuz M, Viola R, Doro P, Hajdu E, Soos G. Quantitative disparities in outpatient antibiotic exposure in a Hungarian county. *Journal of Antimicrobial Chemotherapy*. 2008;**62**(6):1448–50.
- **31** Sutton A, Abrams K, Jones D, Sheldon T, Song F. *Methods for Meta-Analysis in Medical Research*. Chichester, John Wiley & Sons, 2002.
- **32** Higgins J, Green S, eds. *Cochrane Handbook for Systematic Reviews of Interventions*, Version 5.1.0. The Cochrane Collaboration, 2011.
- 33 Schriger DL, Altman DG, Vetter JA, Heafner T, Moher D. Forest plots in reports of systematic reviews: a cross-sectional study reviewing current practice. *International Journal of Epidemiology*. 2010;39(2):421–9.
- 34 Ljungman C, Kahan T, Schioler L, Hjerpe P, Hasselstrom J, Wettermark B, et al. Gender differences in antihypertensive drug treatment: results from the Swedish Primary Care Cardiovascular Database (SPCCD). *Journal of the American Society of Hypertension*. 2014;8(12):882–90.
- **35** Rich JT, Neely JG, Paniello RC, Voelker CC, Nussenbaum B, Wang EW. A practical guide to understanding Kaplan-Meier curves. *Otolaryngology Head and Neck Surgery*. 2010;**143**(3):331–6.

- **36** Krzywinski M. Points of view: axes, ticks and grids. *Nature Methods.* 2013;**10**(3):183.
- **37** Harrower M, Brewer C. ColorBrewer.org: an online tool for selecting colour schemes for maps. *Cartographic Journal*. 2003;**40**(1):27–37.
- **38** ColorBrewer. A web tool selecting colors and maps: www.ColorBrewer.org.
- **39** Google Drive with Motion Chart: www.gapminder .org.
- **40** Gapminder World: www.gapminder.org/world.
- **41** OECD data lab: http://www.oecd.org/statistics/dat-alab/#d.en.227006.
- **42** OECD Factbook Explorer: http://www.oecd.org/publications/factbook/.
- **43** Keim DA. Information visualization and visual data mining. *IEEE Transactions on Visualization and Computer Graphic*. 2002;**8**:1–8.
- **44** Wegman E. Hyperdimensional data analysis using parallel coordinates. *Journal of the American Statistical Association*. 1990;**85**:664–75.
- **45** Segel E, Heer J. Narrative visualization: telling stories with data. *IEEE Transactions on Visualization and Computer Graphic*. 2010;**16**:1139–48.
- **46** Power BI for Microsoft Office 365: http://www.microsoft.com/en-us/powerbi/default.aspx.
- 47 Tableau: www.tableau.com.
- **48** Qlik Technologiest: www.qlik.com.
- 49 Ggobi: www.ggobi.org.
- **50** Orange: orange.biolab.si.
- **51** Yau N. Visualize This: The Flowing Data Guide to Design, Visualization, and Statistics. Chichester, John Wiley & Sons, 2011.

- 1 Merlo J, Chaix B, Yang M, Lynch J, Rastam L. A brief conceptual tutorial of multilevel analysis in social epidemiology: linking the statistical concept of clustering to the idea of contextual phenomenon. *Journal of Epidemiology & Community Health*. 2005;**59**(6):443−9.
- **2** Merlo J, Chaix B, Yang M, Lynch J, Rastam L. A brief conceptual tutorial on multilevel analysis in social epidemiology: interpreting neighbourhood differences and the effect of neighbourhood characteristics on individual health. *Journal of Epidemiology & Community Health*. 2005;**59**(12):1022–8.
- **3** Merlo J, Yang M, Chaix B, Lynch J, Rastam L. A brief conceptual tutorial on multilevel analysis in social epidemiology: investigating contextual phenomena in different groups of people. *Journal of Epidemiology & Community Health*. 2005;**59**(9):729–36.
- 4 Merlo J, Chaix B, Ohlsson H, Beckman A, Johnell K, Hjerpe P, et al. A brief conceptual tutorial of multilevel analysis in social epidemiology: using measures of clustering in multilevel logistic regression to investigate contextual phenomena. *Journal of Epidemiology & Community Health*. 2006;60(4):290−7.
- **5** Leyland A, Goldstein H. Multilevel modelling of health statistics. Chichester, John Wiley & Sons, 2001.
- **6** Snijders TAB. *Multilevel Analysis: An Introduction to Basic and Advanced Multilevel Modeling,* 2nd edn. Thousand Oaks, CA, Sage Publications, 2011.
- **7** Hjerpe P, Ohlsson H, Lindblad U, Bostrom KB, Merlo J. Understanding adherence to therapeutic guidelines: a multilevel analysis of statin prescription in the Skaraborg Primary Care Database. *European Journal of Clinical Pharmacology*. 2011;**67**(4):415–23.
- **8** Singer JD, Willett JB. Applied Longitudinal Data Analysis: Modeling Change and Event Occurrence.

- Oxford and New York, Oxford University Press, 2003.
- **9** Leckie G, Goldstein H. Understanding uncertainty in school league tables. *Fiscal Studies*. 2011;doi:10.11 11/j.1475-5890.2011.00133.
- **10** Merlo J, Viciana-Fernandez FJ, Ramiro-Farinas D; Research Group of Longitudinal Database of Andalusian Population. Bringing the individual back to small-area variation studies: a multilevel analysis of all-cause mortality in Andalusia, Spain. *Social Science* & Medicine. 2012;**75**(8):1477−87.
- 11 Merlo J, Ostergren PO, Broms K, Bjorck-Linne A, Liedholm H. Survival after initial hospitalisation for heart failure: a multilevel analysis of patients in Swedish acute care hospitals. *Journal of Epidemiology & Community Health*. 2001;55(5):323–9.
- 12 Merlo J, Gerdtham UG, Eckerlund I, Hakansson S, Otterblad-Olausson P, Pakkanen M, et al. Hospital level of care and neonatal mortality in lowand high-risk deliveries: reassessing the question in Sweden by multilevel analysis. *Medical Care*. 2005;43(11):1092–100.
- **13** Hjerpe P, Ohlsson H, Lindblad U, Bostrom KB, Merlo J. Understanding adherence to therapeutic guidelines: a multilevel analysis of statin prescription in the Skaraborg Primary Care Database. *European Journal of Clinical Pharmacology*. 2011;**67**(4):415–23.
- 14 Ohlsson H, Chaix B, Merlo J. Therapeutic traditions, patient socioeconomic characteristics and physicians' early new drug prescribing a multilevel analysis of rosuvastatin prescription in south Sweden. *European Journal of Clinical Pharmacology*. 2009;65(2):141–50.
- **15** Ohlsson H, Librero J, Sundquist J, Sundquist K, Merlo J. Performance evaluations and league tables: do they capture variation between organizational units? An analysis of 5 Swedish phar-

- macological performance indicators. *Medical Care*. 2011;**49**(3):327–31.
- **16** de Jong JD, Groenewegen PP, Spreeuwenberg P, Westert GP, de Bakker DH. Do decision support systems influence variation in prescription? *BMC Health Services Research*. 2009;**9**:20.
- 17 Davis P, Gribben B. Rational prescribing and interpractitioner variation. A multilevel approach. *International Journal of Technology Assessment in Health Care*. 1995;11(3):428–42.
- **18** Ohlsson H, Vervloet M, van Dijk L. Practice variation in a longitudinal perspective: a multilevel analysis of the prescription of simvastatin in general practices between 2003 and 2009. *European Journal of Clinical Pharmacology*. 2011;**67**(12):1205–11.
- 19 Vervloet M, Spreeuwenberg P, Bouvy ML, Heerdink ER, de Bakker DH, van Dijk L. Lazy sunday afternoons: the negative impact of interruptions in patients' daily routine on adherence to oral antidiabetic medication. A multilevel analysis of electronic monitoring data. *European Journal of Clinical Pharmacology*. 2013;69(8):1599–606.
- **20** Merlo J, Liedholm H, Lindblad U, Bjorck-Linne A, Falt J, Lindberg G, et al. Prescriptions with potential drug interactions dispensed at Swedish pharmacies in January 1999: cross sectional study. *British Medical Journal*. 2001;**323**(7310):427–8.
- **21** Browne WJ, Goldstein H, Rasbash J. Multiple membership multiple classification (MMMC) models. *Statistical Modelling*. 2001;**1**:103–24.
- **22** Browne WJ, Goldstein H, Rasbash J. Multiple membership multiple classification (MMMC) models. *Statistical Modelling*. 2001;**1**(2):103–24.
- **23** Killip S, Mahfoud Z, Pearce K. What is an intracluster correlation coefficient? Crucial concepts for primary care researchers. *Annals of Family Medicine*. 2004;**2**(3):204–8.
- **24** Merlo J. Changing analytical approaches in European epidemiology a short comment on a recent article. *European Journal of Epidemiology*. 2005;**20**(8):737; author reply 8.
- **25** Morgenstern H. Ecological studies. In: Rothman KJ, Greenland S, eds. *Modern Epidemiology*, 2nd edn. Philadelphia, Lippincott-Raven, 1998: 459–80.
- **26** Merlo J, Ostergren PO, Hagberg O, Lindstrom M, Lindgren A, Melander A, et al. Diastolic blood pressure and area of residence: multilevel versus ecological analysis of social inequity.

- Journal of Epidemiology & Community Health. 2001;**55**(11):791−8.
- 27 Öppna jämförelser av hälso- och sjukvårdens kvalitet och effektivitet Jämförelser mellan landsting 2008. Stockholm. 2009.
- **28** Adab P, Rouse AM, Mohammed MA, Marshall T. Performance league tables: the NHS deserves better. *British Medical Journal (Clinical Research Edition)*. 2002;**324**(7329):95–8.
- **29** Goldstein H, Spiegelhalter D. League tables and their limitations: statistical issues in comparisions of institutional performance. *Journal of the Royal Statistical Society Series A.* 1996;**159**(Part 3):385–443.
- **30** Ibanez B, Librero J, Bernal-Delgado E, Peiro S, Gonzalez Lopez-Valcarcel B, Martinez N, et al. Is there much variation in variation? Revisiting statistics of small area variation in health services research. *BMC Health Services Research*. 2009;**9**(1):60.
- **31** Thomas N, Longford NT, Rolph JE. Empirical Bayes methods for estimating hospital-specific mortality rates. *Statistics in Medicine*. 1994; **13**(9):889–903.
- 32 van Houwelingen H, Brand R, Louis T. Empirical Bayes methods for monitoring health care quality. Available from: http://www.researchgate.net/publication/238566111_Empirical_Bayes_methods_for_monitoring_health_care_quality (last accessed 18 November 2015).
- **33** Bird S, Cox D, Farewell V, Goldstein H, Holt T, Smith P. Performance indicators: good, bad and ugly. *Journal of the Royal Statistical Society Series A*. 2005;**168**(1):1–27.
- **34** Leyland AH, Boddy FA. League tables and acute myocardial infarction. *Lancet.* 1998;**351**(9102): 555–8.
- **35** Petronis KR, Anthony JC. A different kind of contextual effect: geographical clustering of cocaine incidence in the USA. *Journal of Epidemiology and Community Health*. 2003;**57**(11):893–900.
- **36** Wagner P, Merlo J. Measures of discriminatory accuracy in multilevel analysis. *European Journal of Epidemiology*. 2013;**28**(1 Suppl.):135.
- **37** Merlo J, Asplund K, Lynch J, Rastam L, Dobson A. Population effects on individual systolic blood pressure: a multilevel analysis of the World Health Organization MONICA Project. *American Journal of Epidemiology*. 2004;**159**(12):1168–79.
- **38** Ohlsson H, Lindblad U, Lithman T, Ericsson B, Gerdtham UG, Melander A, et al. Understanding

- adherence to official guidelines on statin prescribing in primary health care a multi-level methodological approach. *European Journal of Clinical Pharmacology*. 2005;**61**(9):657–65.
- 39 Rasbash J, Browne W, Goldstein H, Yang M, Plewis I, Healy M, et al. Modelling the variance as a function of explanatory variables. A user's guide to MLwiN Version 21. version 2.1. Multilevels Models Project, Institute of Education, University of London, 2000: 77–88.
- **40** Merlo J. Multilevel analytical approaches in social epidemiology: measures of health variation compared with traditional measures of association. *Journal of Epidemiology & Community Health*. 2003;**57**(8):550−2.
- **41** Merlo J, Ohlsson H, Lynch KF, Chaix B, Subramanian SV. Individual and collective bodies: using measures of variance and association in contextual epidemiology. *Journal of Epidemiology & Community Health*. 2009;**63**(12):1043–8.
- **42** Wagner P, Merlo J. Discriminatory accuracy of a random effect in multilevel logistic regression. 20th IEA World Congress of Epidemiology (WCE2014). 2014.
- **43** Merlo J, Wagner P. Assessment of Specific and General Contextual Effects in Observational Epidemiology: Multilevel Logistic Regression Analysis of Discriminatory Accuracy. Working Paper. 2014.
- **44** Fung V, Schmittdiel J, Fireman B, Meer A, Thomas S, Smider N, et al. Meaningful variation in performance. *Medical Care*. 2010;**48**(2):140–8.
- **45** Merlo J. Invited commentary: multilevel analysis of individual heterogeneity a fundamental critique of the current probabilistic risk factor epidemiology. *American Journal of Epidemiology.* 2014;**180**(2):208–12: disc. 213–14.
- **46** Merlo J. Invited commentary: multilevel analysis of individual heterogeneity a fundamental critique of the current probabilistic risk factor epidemiology. *American Journal of Epidemiology*, 2014;**180**(2):208–12.
- **47** Merlo J, Lynch JW, Yang M, Lindstrom M, Ostergren PO, Rasmusen NK, et al. Effect of neighbor-

- hood social participation on individual use of hormone replacement therapy and antihypertensive medication: a multilevel analysis. *American Journal of Epidemiology.* 2003;**157**(9):774–83.
- **48** Ohlsson H, Merlo J. Is there important variation among health care institutions? *Medical Care*. 2010;**48**(8):757–8; author reply 8.
- **49** Benson HR. An introduction to benchmarking in healthcare. *Radiology Management*. 1994;**16**(4):35–9.
- 50 Larsen K, Merlo J. Appropriate assessment of neighborhood effects on individual health: integrating random and fixed effects in multilevel logistic regression. *American Journal of Epidemiology*. 2005;161(1):81–8.
- **51** Li J, Gray BR, Bates DM. An empirical study of statistical properties of variance partition coefficients for multi-level logistic regression models. *Communications in Statistics Simulation and Computation*. 2008;**37**:2010–26.
- 52 Browne WJ, Subramanian SV, Jones K, Goldstein H. Variance partitioning in multilevel logistic models that exhibit overdispersion. *Journal of the Royal Statistical Society: Series A (Statistics in Society)*. 2005;168(3):599–613.
- **53** Goldstein H, Browne W, Rasbash J. Partitioning variation in generalised linear multilevel models. *Understanding Statistics*. 2002;1:223–32.
- **54** Ohlsson H, Chaix B, Merlo J. Therapeutic traditions, patient socioeconomic characteristics and physicians' early new drug prescribing a multilevel analysis of rosuvastatin prescription in south Sweden. *European Journal of Clinical Pharmacology*. 2009;**65**(2):141–50.
- 55 Campbell MK, Piaggio G, Elbourne DR, Altman DG, Group C. Consort 2010 statement: extension to cluster randomised trials. *British Medical Journal*. 2012;345:e5661.
- **56** Larsen K, Petersen JH, Budtz-Jorgensen E, Endahl L. Interpreting parameters in the logistic regression model with random effects. *Biometrics*. 2000;**56**(3):909–14.

- 1 Kohn L, Corrigan J, Donaldson M. To err is human. Building a safer health system. Committee on Quality of Healthcare in America. Institute of Medicine. Washington, DC, National Academy Press, 1999.
- **2** Garattini S, Bertele V, Godman B, Haycox A, Wettermark B, Gustafsson LL. Enhancing the rational use of new medicines across European health care systems. *European Journal of Clinical Pharmacology*. 2008:**64**:1137–8.
- **3** Godman B, Paterson K, Malmstrom RE, Selke G, Fagot JP, Mrak J. Improving the managed entry of new medicines: sharing experiences across Europe. *Expert Review of Pharmacoeconomics & Outcomes Research*. 2012;**12**:439–41.
- **4** Wettermark B, Godman B, Jacobsson B, Haaijer-Ruskamp FM. Soft regulations in pharmaceutical policy making: an overview of current approaches and their consequences. *Applied Health Economics and Health Policy*. 2009;**7**:137–47.
- 5 World Health Organization. The rational use of drugs. WHO Report of the Conference of Experts, Nairobi. Geneva, World Health Organization, 1985.
- **6** Sjöqvist F, Borgå O, Dahl ML, Orme MLE. Fundamentals of clinical pharmacology. In: Speight T, ed. *Avery's Drug Treatment*, 4th edn. Auckland: Adis Press, 1997: 1–73.
- **7** Zolnierek KB, Dimatteo MR. Physician communication and patient adherence to treatment: a meta-analysis. *Medical Care*. 2009;**47**:826–34.
- **8** Spinewine A, Fialova D, Byrne S. The role of the pharmacist in optimizing pharmacotherapy in older people. *Drugs & Aging*. 2012;**29**:495–510.
- **9** Avery AJ, Rodgers S, Cantrill JA, et al. A pharmacist-led information technology intervention for medication errors (PINCER): a multicentre, cluster randomised, controlled trial and cost-effectiveness analysis. *Lancet*. 2012;**379**:1310–19.

- 10 Ojeleye O, Avery A, Gupta V, Boyd M. The evidence for the effectiveness of safety alerts in electronic patient medication record systems at the point of pharmacy order entry: a systematic review. BMC Medical Informatics and Decision Making. 2013;13:69.
- 11 Osterberg L, Blaschke T. Adherence to medication. *The New England Journal of Medicine*. 2005;**353**: 487–97.
- 12 Makoul G, Arntson P, Schofield T. Health promotion in primary care: physician-patient communication and decision making about prescription medications. *Social Science & Medicine (1982)*. 1995;41:1241–54.
- **13** McCann LM, Haughey SL, Parsons C, et al. A patient perspective of pharmacist prescribing: 'crossing the specialisms-crossing the illnesses'. *Health Expectations*. 2015;**18**(1):58–68.
- **14** Sabate E. *Adherence to Long Term Therapies: Evidence for Action.* Geneva, World Health Organization, 2003.
- 15 Haaijer-Ruskamp FM, Hoven JL, Mol PGM. A Conceptual Framework for Constructing Prescribing Quality Indicators. DURQUIM Meeting Report, 2004.
- **16** Avery AJ, Dex GM, Mulvaney C, et al. Development of prescribing-safety indicators for GPs using the RAND Appropriateness Method. *British Journal of General Practice*. 2011;**61**:e526–36.
- **17** Morris CJ, Rodgers S, Hammersley VS, Avery AJ, Cantrill JA. Indicators for preventable drug related morbidity: application in primary care. *Quality & Safety in Health Care*. 2004;**13**:181–5.
- **18** van Zwanenberg TD, Grant GB, Gregory DA. Can rational prescribing be assessed? *Journal of the Royal College of General Practitioners*. 1987;**37**:308–10.
- 19 Bateman DN, Eccles M, Campbell M, Soutter J, Roberts SJ, Smith JM. Setting standards of prescribing performance in primary care: use of a consensus group of general practitioners and application of standards to practices in the north of England. *British Journal of General Practice*. 1996;46:20–5.

- 20 Buetow SA, Sibbald B, Cantrill JA, Halliwell S. Prevalence of potentially inappropriate long term prescribing in general practice in the United Kingdom, 1980–95: systematic literature review. *British Medical Journal (Clinical Research Edition)*. 1996;313:1371–4.
- **21** Campbell SM, Cantrill JA, Roberts D. Prescribing indicators for UK general practice: Delphi consultation study. *British Medical Journal (Clinical Research Edition)*. 2000;**321**:425–8.
- 22 Crooks J. The concept of medical auditing. In: *Drug Utilization Studies: Implications for Medical Care. Proceedings from ANIS symposium, Sånga-Säby, Sweden.* Apoteksbolaget AB, Stockholm, 1982.
- **23** Frischer M, Heatlie H, Chapman S, Norwood J, Bashford J, Millson D. Should the corticosteroid to bronchodilator ratio be promoted as a quality prescribing marker? *Public Health*. 1999;**113**:247–50.
- **24** Campbell SM, Braspenning J, Hutchinson A, Marshall MN. Research methods used in developing and applying quality indicators in primary care. *British Medical Journal (Clinical Research Edition)*. 2003;**326**:816–19.
- **25** Wollersheim H, Hermens R, Hulscher M, et al. Clinical indicators: development and applications. *The Netherlands Journal of Medicine*. 2007;**65**:15–22.
- 26 Braspenning J, Hermens R, Calsbeek H, Westert G, Campbell S, Grol R. Quality and safety of care: the role of indicators. In: Grol R, Wensing M, Eccles M, Davis D, eds. *Improving Patient Care: The Implementation of Change in Health Care*, 2nd edn. Chichester, Wiley-Blackwell, 2013.
- 27 Sketris IS, Fisher JE, Langille Ingram EM, Bergman U, Andersen M, Vlahovic-Palckevski V. Prescribing indicators: what can Canada learn from European countries? *Journal of Population Therapeutics and Clinical Pharmacology*. 2012;19:e78–98.
- **28** Wettermark B, Pehrsson A, Juhasz-Haverinen M, et al. Financial incentives linked to self-assessment of prescribing patterns: a new approach for quality improvement of drug prescribing in primary care. *Quality in Primary Care*. 2009;**17**:179–89.
- **29** Scott A, Sivey P, Ait Ouakrim D, et al. The effect of financial incentives on the quality of health care provided by primary care physicians. *The Cochrane Database of Systematic Reviews*. 2011:CD008451.
- **30** Gillam SJ, Siriwardena AN, Steel N. Pay-for-performance in the United Kingdom: impact of

- the quality and outcomes framework: a systematic review. *Annals of Family Medicine*. 2012;**10**:461–8.
- **31** Eijkenaar F, Emmert M, Scheppach M, Schoffski O. Effects of pay for performance in health care: a systematic review of systematic reviews. *Health Policy*. 2013:**110**:115–30.
- **32** Lawrence M, Olesen F. Indicators of quality in healthcare. *European Journal of General Practice*. 1997;**3**:103–8.
- 33 Haaijer-Ruskamp FM, Andersen M, Vander Stichele RH. Prescribing quality indicators. In: Hartzema AG, Tilson HH, Chan AK, eds. *Pharmacoepidemiology and Therapeutic Risk Assessment*. Cincinatti, OH, Harwey Whitney Books, 2008.
- **34** Shekelle PG. Quality indicators and performance measures: methods for development need more standardization. *Journal of Clinical Epidemiology*. 2013;**66**:1338–9.
- **35** Berwick DM, Nolan TW, Whittington J. The triple aim: care, health, and cost. *Health Affairs (Project Hope)*. 2008;**27**:759–69.
- **36** Stiefel M, Nolan K. Measuring the triple aim: a call for action. *Population Health Management*. 2013:**16**:219–20.
- **37** Institute of Medicine. *Crossing the Quality Chasm: A New Health System for the 21st Century.* Washington, DC, National Academies Press, 2001.
- **38** Campbell SM, Roland MO, Buetow SA. Defining quality of care. *Social Science & Medicine* (1982). 2000;**51**:1611–25.
- **39** Donabedian A. *The Definition of Quality and Approaches to Its Assessment. Vol. 1. Explorations in Quality Assessment and Monitoring.* Ann Arbor, MI, Health Administration Press, 1980.
- **40** Donabedian A. The quality of care. How can it be assessed? *Journal of the American Medical Association*. 1988;**260**:1743–8.
- **41** Brook RH, McGlynn EA, Cleary PD. Quality of health care. Part 2: measuring quality of care. *New England Journal of Medicine*. 1996;**335**:966–70.
- **42** Salzer MS, Nixon CT, Schut LJ, Karver MS, Bickman L. Validating quality indicators. Quality as relationship between structure, process, and outcome. *Evaluation Review.* 1997;**21**:292–309.
- **43** Eichler HG, Abadie E, Breckenridge A, et al. Bridging the efficacy-effectiveness gap: a regulator's perspective on addressing variability of drug response. *Nature Reviews Drug Discovery*. 2011;**10**:495–506.

- **44** Campbell SM, Eriksson T. Multiple strategies for quality improvement and patient safety money alone is not the answer, nor is trust. Conclusions of the 6th EQuiP Invitational Conference April 2011. *European Journal of General Practice*. 2011;**17**:238–40.
- **45** Campbell S, Tickle M. What is quality primary dental care? *British Dental Journal*. 2013;**215**:135–9.
- **46** Godman B, Finlayson AE, Cheema PK, et al. Personalizing health care: feasibility and future implications. *BMC Medicine*. 2013;**11**:179.
- **47** Finlayson AE, Godman B, Paterson K, et al. Personalizing healthcare: from genetics through payment to improving care? *Journal of the Royal Society of Medicine*. 2013;**106**:41–4.
- **48** Martirosyan L, Markhorst J, Denig P, Haaijer-Ruskamp FM, Braspenning J. A pilot qualitative study to explore stakeholder opinions regarding prescribing quality indicators. *BMC Health Services Research*. 2012;**12**:191.
- **49** Adams AS, Soumerai SB, Lomas J, Ross-Degnan D. Evidence of self-report bias in assessing adherence to guidelines. *International Journal for Quality in Health Care*, 1999:**11**:187–92.
- **50** Powell AE, Davies HT, Thomson RG. Using routine comparative data to assess the quality of health care: understanding and avoiding common pitfalls. *Quality & Safety in Health Care*. 2003;**12**:122−8.
- **51** Andersen M. Is it possible to measure prescribing quality using only prescription data? *Basic & Clinical Pharmacology & Toxicology*. 2006;**98**:314−19.
- **52** Sorensen HT, Sabroe S, Olsen J. A framework for evaluation of secondary data sources for epidemiological research. *International Journal of Epidemiology*. 1996;**25**:435–42.
- 53 Hippisley-Cox J, Coupland C. Unintended effects of statins in men and women in England and Wales: population based cohort study using the QResearch database. *British Medical Journal (Clinical Research Edi*tion). 2010;340:c2197.
- **54** World Health Organization. World Health Statistics 2014. Available from: http://apps.who.int/iris/bitstream/10665/112738/1/9789240692671_eng.pdf (last accessed 18 November 2015).
- 55 Björnberg A. Euro Health Consumer Index 2013. Available from: http://www.healthpowerhouse. com/files/ehci-2013/ehci-2013-report.pdf (last accessed 18 November 2015).

- 56 Marshall MN, Shekelle PG, McGlynn EA, Campbell S, Brook RH, Roland MO. Can health care quality indicators be transferred between countries? *Quality & Safety in Health Care*. 2003;12:8–12.
- **57** Klazinga N, Fischer C, ten Asbroek A. Health services research related to performance indicators and benchmarking in Europe. *Journal of Health Services Research & Policy*. 2011;**16**(Suppl. 2):38–47.
- **58** Bradley CP. Decision making and prescribing patterns a literature review. *Family Practice*. 1991;**8**:276–87.
- **59** Holden J, Wilson R. The quality of prescribing in general practice. *International Journal of Health Care Quality Assurance*. 1996;**9**:17–23.
- **60** de Vries CS, Tromp TF, Blijleven W, de Jong-van den Berg LT. Prescription data as a tool in pharmacotherapy audit (I). General considerations. *Pharmacy World & Science*. 1999:**21**:80–4.
- **61** Muijrers PE, Janknegt R, Sijbrandij J, Grol RP, Knottnerus JA. Prescribing indicators. Development and validation of guideline-based prescribing indicators as an instrument to measure the variation in the prescribing behaviour of general practitioners. *European Journal of Clinical Pharmacology*. 2004;**60**:739–46.
- **62** Fernandez Urrusuno R, Montero Balosa MC, Perez Perez P, Pascual de la Pisa B. Compliance with quality prescribing indicators in terms of their relationship to financial incentives. *European Journal of Clinical Pharmacology*. 2013;**69**:1845–53.
- **63** Godman B, Shrank W, Andersen M, et al. Policies to enhance prescribing efficiency in europe: findings and future implications. *Frontiers in Pharmacology*. 2010;**1**:141.
- **64** Robertson J, Fryer JL, O'Connell DL, Smith AJ, Henry DA. Limitations of Health Insurance Commission (HIC) data for deriving prescribing indicators. *Medical Journal of Australia*. 2002;**176**:419–24.
- 65 Avorn J, Soumerai SB. Improving drug-therapy decisions through educational outreach. A randomized controlled trial of academically based 'detailing'. New England Journal of Medicine. 1983;308:1457–63.
- **66** Beers MH. Explicit criteria for determining potentially inappropriate medication use by the elderly. An update. *Archives of Internal Medicine*. 1997;**157**: 1531–6.

- 4
- **67** Carnovale C, Conti V, Perrone V, et al. Paediatric drug use with focus on off-label prescriptions in Lombardy and implications for therapeutic approaches. *European Journal of Pediatrics*. 2013;**172**:1679–85.
- **68** Avery AJ, Heron T, Harris CM, Roberts D, Lloyd D. Assessing measures of the range of non-steroidal anti-inflammatory drugs prescribed by general practices as prescribing performance indicators. *British Journal of Medical Economics*. 1996;**10**:69–78.
- **69** Kamps G, Stewart R, van Der Werf G, Schuling J, Jong BM. Adherence to the guidelines of a regional formulary. *Family Practice*. 2000;**17**:254–60.
- **70** Mackinnon NJ, Hepler CD. Preventable drug-related morbidity in older adults 1. Indicator development. *Journal of Managed Care Pharmacy*. 2002;**8**:365–71.
- **71** Bergman U, Popa C, Tomson Y, et al. Drug utilization 90% a simple method for assessing the quality of drug prescribing. *European Journal of Clinical Pharmacology*. 1998;**54**:113–18.
- 72 Bergman U, Wettermark B. Setting up and using the DU90% technique a simple indicator for assessing the quality of drug prescribing. In: McGavock H, ed. *Handbook of Drug Use Research Methodology*, 1st edn. Newcastle upon Tyne, United Kingdom Drug Utilization Research Group, 2000: 155–63.
- 73 Wettermark B. Drug Utilization 90%: Using Aggregate Drug Statistics for the Quality Assessment of Prescribing. Stockholm, Karolinska Institutet, 2004.
- **74** Wettermark B, Vlahovic-Palcevski V, Laing R, Bergman U. Adherence to WHOs essential medicines list in two European countries. *WHO Drug Information*. 2006;**20**:78–85.
- 75 Plet HT, Hallas J, Kjeldsen LJ. Adherence to hospital drug formularies and cost of drugs in hospitals in Denmark. *European Journal of Clinical Pharmacology*. 2013;**69**:1837–43.
- 76 Goryachkina K, Babak S, Burbello A, Wettemark B, Bergman U. Quality use of medicines: a new method of combining antibiotic consumption and sensitivity data application in a Russian hospital. *Pharmacoepidemiology and Drug Safety*. 2008;17:636–44.
- 77 Larsen J, Vaccheri A, Andersen M, Montanaro N, Bergman U. Lack of adherence to lipid-lowering drug treatment. A comparison of utilization patterns in defined populations in Funen, Denmark and Bologna, Italy. *British Journal of Clinical Pharmacology*. 2000;49:463–71.

- **78** Gaist D, Hallas J, Hansen NC, Gram LF. Are young adults with asthma treated sufficiently with inhaled steroids? A population-based study of prescription data from 1991 and 1994. *British Journal of Clinical Pharmacology*. 1996;**41**:285–9.
- **79** Arnlind MH, Wettermark B, Nokela M, Hjemdahl P, Rehnberg C, Jonsson EW. Regional variation and adherence to guidelines for drug treatment of asthma. *European Journal of Clinical Pharmacology*. 2010;**66**:187–98.
- **80** Frisk P, Mellgren TO, Hedberg N, Berlin A, Granath F, Wettermark B. Utilisation of angiotensin receptor blockers in Sweden: combining survey and register data to study adherence to prescribing guidelines. *European Journal of Clinical Pharmacology*. 2008;**64**:1223–9.
- **81** van Dijk KN, Pont LG, de Vries CS, Franken M, Brouwers JR, de Jong-van den Berg LT. Prescribing indicators for evaluating drug use in nursing homes. *Annals of Pharmacotherapy*. 2003;**37**:1136–41.
- **82** Linnarsson R. Drug interactions in primary health care. A retrospective database study and its implications for the design of a computerized decision support system. *Scandinavian Journal of Primary Health Care*. 1993;**11**:181–6.
- **83** Gaist D, Tsiropoulos I, Sindrup SH, et al. Inappropriate use of sumatriptan: population based register and interview study. *British Medical Journal (Clinical Research Edition)*. 1998;**316**:1352–3.
- **84** Davidsen JR, Hallas J, Sondergaard J, et al. Association between prescribing patterns of anti-asthmatic drugs and clinically uncontrolled asthma: a cross-sectional study. *Pulmonary Pharmacology & Therapeutics*. 2011;**24**:647–53.
- **85** Yeaw J, Benner JS, Walt JG, Sian S, Smith DB. Comparing adherence and persistence across 6 chronic medication classes. *Journal of Managed Care Pharmacy*. 2009;**15**:728–40.
- **86** Qvarnstrom M, Kahan T, Kieler H, et al. Persistence to antihypertensive drug treatment in Swedish primary healthcare. *European Journal of Clinical Pharmacology*. 2013;**69**:1955–64.
- **87** Veninga CC, Denig P, Pont LG, Haaijer-Ruskamp FM. Comparison of indicators assessing the quality of drug prescribing for asthma. *Health Services Research*. 2001;**36**:143–61.
- **88** Dreischulte T, Grant AM, McCowan C, McAnaw JJ, Guthrie B. Quality and safety of medication use in primary care: consensus validation of a new set of

- explicit medication assessment criteria and prioritisation of topics for improvement. *BMC Clinical Pharmacology*. 2012;**12**:5.
- **89** Cheng EM, Fung CH. Quality indicators for the care of stroke and atrial fibrillation in vulnerable elders. *Journal of the American Geriatrics Society*. 2007;**55**(Suppl. 2):S431–7.
- 90 Hermann R, Mattke S; Members of the OECD Mental Health Care Panel. Selecting Indicators for the Quality of Mental Health Care at the Health Systems Level in OECD Countries. Organisation for Economic Co-operation and Development, 2004.
- **91** Strøm H, Sakshaug S, Skurtveit S. Use of statins in patients receiving oral blood glucose-lowering drugs. *Norsk Epidemiologi*. 2008;**18**:191–4.
- **92** Ashworth M, Golding S, Majeed A. Prescribing indicators and their use by primary care groups to influence prescribing. *Journal of Clinical Pharmacy and Therapeutics*. 2002;**27**:197–204.
- 93 Adriaenssens N, Coenen S, Tonkin-Crine S, Verheij TJ, Little P, Goossens H. European Surveillance of Antimicrobial Consumption (ESAC): disease-specific quality indicators for outpatient antibiotic prescribing. *British Medical Journal Quality & Safety*. 2011.
- **94** Campbell SM, Reeves D, Kontopantelis E, Sibbald B, Roland M. Effects of pay for performance on the quality of primary care in England. *New England Journal of Medicine*. 2009;**361**:368–78.
- 95 Schubert, Koster, Ihle P, von Ferber L. Development of indicators for assessing the quality of prescribing of lipid-lowering drugs: data from the pharmacotherapeutic quality circles in Hesse, Germany. *International Journal of Clinical Pharmacology and Therapeutics*. 2001:39:492–8.
- **96** Persell SD, Kaiser D, Dolan NC, et al. Changes in performance after implementation of a multifaceted electronic-health-record-based quality improvement system. *Medical Care*. 2011;**49**:117–25.
- 97 Guthrie B, McCowan C, Davey P, Simpson CR, Dreischulte T, Barnett K. High risk prescribing in primary care patients particularly vulnerable to adverse drug events: cross sectional population database analysis in Scottish general practice. *British Medical Journal (Clinical Research Edition)*. 2011;342:d3514.
- **98** Fleetcroft R, Cookson R, Steel N, Howe A. Correlation between prescribing quality and pharmaceutical costs in English primary care: national cross-

- sectional analysis. *The British Journal of General Practice*, 2011;**61**:e556–64.
- **99** Voorham J, Denig P, Wolffenbuttel BH, Haaijer-Ruskamp FM. Cross-sectional versus sequential quality indicators of risk factor management in patients with type 2 diabetes. *Medical Care*. 2008:**46**:133–41.
- **100** van Doorn-Klomberg AL, Braspenning JC, Feskens RC, Bouma M, Campbell SM, Reeves D. Precision of individual and composite performance scores: the ideal number of indicators in an indicator set. *Medical Care*. 2013;**51**:115–21.
- **101** Reeves D, Campbell SM, Adams J, Shekelle PG, Kontopantelis E, Roland MO. Combining multiple indicators of clinical quality: an evaluation of different analytic approaches. *Medical Care*. 2007;**45**:489–96.
- 102 Hoven JL, Haaijer-Ruskamp FM, Vander Stichele RH. Indicators of prescribing quality in drug utilisation research: report of a European meeting (DURQUIM, 13–15 May 2004). *European Journal of Clinical Pharmacology*. 2005;60:831–4.
- 103 Rasmussen HM, Sondergaard J, Kampmann JP, Andersen M. General practitioners prefer prescribing indicators based on detailed information on individual patients: a Delphi study. *European Journal of Clinical Pharmacology*, 2005;61:237–41.
- **104** Pont LG, Denig P, van der Molen T, van der Veen WJ, Haaijer-Ruskamp FM. Validity of performance indicators for assessing prescribing quality: the case of asthma. *European Journal of Clinical Pharmacology*. 2004;**59**:833–40.
- **105** Buusman A, Kragstrup J, Andersen M. General practitioners choose within a narrow range of drugs when initiating new treatments: a cohort study of cardiovascular drug formularies. *European Journal of Clinical Pharmacology*. 2005;**61**:651–6.
- **106** Skyggedal Rasmussen HM, Sondergaard J, Sokolowski I, Kampmann JP, Andersen M. Factor analysis improves the selection of prescribing indicators. *European Journal of Clinical Pharmacology*. 2006;**62**:953–8.
- **107** Campbell SM, Godman B, Diogene E, et al. Quality indicators as a tool in improving the introduction of new medicines. *Basic Clinical Pharmacology & Toxicology.* 2015;**116**(2):146–57.
- **108** Chassin MR, Loeb JM, Schmaltz SP, Wachter RM. Accountability measures using measurement to

- promote quality improvement. *New England Journal of Medicine*. 2010;**363**:683–8.
- 109 Martirosyan L, Voorham J, Haaijer-Ruskamp FM, Braspenning J, Wolffenbuttel BH, Denig P. A systematic literature review: prescribing indicators related to type 2 diabetes mellitus and cardiovascular risk management. *Pharmacoepidemiology and Drug Safety*. 2010;19:319–34.
- 110 Sidorenkov G, Haaijer-Ruskamp FM, de Zeeuw D, Bilo H, Denig P. Review: relation between quality-of-care indicators for diabetes and patient outcomes: a systematic literature review. *Medical Care Research and Review.* 2011;68:263–89.

- **1** Mays N, Pope C. Qualitative research: rigour and qualitative research. *British Medical Journal*. 1995;**311**:109–12.
- **2** Mays N, Pope C. Assessing quality in qualitative research. *British Medical Journal*. 2000;**320**:50–2.
- **3** Mays N, Pope C. Qualitative research: observational methods in health care settings. *British Medical Journal*. 1995;**311**:182–4.
- **4** Pope C, Mays N. Qualitative research: reaching the parts other methods cannot reach: an introduction to qualitative methods in health and health services research. *British Medical Journal*. 1995;**311**:42–5.
- **5** Pope C, Mays N. Opening the black box: an encounter in the corridors of health services research. *British Medical Journal*. 1993;**306**:315–18.
- **6** Pope C, Ziebland S, Mays N. Analysing qualitative data. *British Medical Journal*. 2000;**320**:114–16.
- 7 World Health Organization. *Introduction to Drug Utilization Research*. Oslo, World Health Organization, 2003.
- **8** Björnsdóttir I, Almarsdóttir A, Traulsen J. The lay public's explicit and implicit definitions of drugs. *Research in Social and Administrative Pharmacy*. 2009;**5**:40–50.
- **9** Bissell P, Traulsen JM. *Sociology and Pharmacy Practice*. London, Pharmaceutical Press, 2005.
- **10** Helman C. *Culture, Health and Illness,* 5th edn. Boca Raton, FL, CRC Press, 2007.
- 11 Noerreslet M, Jemec GBE, Traulsen JM. Involuntary autonomy: patients' perceptions of physicians, conventional medicines and risks in the management of atopic dermatitis. *Social Science & Medicine*. 2009;69:1409−15.
- 12 Kardakis T, Tomson G, Wettermark B, Brommels M, Godman B, Bastholm-Rahmner P. The establishment and expansion of an innovative centre for

- rational pharmacotherapy determinants and challenges. *International Journal of Health Planning and Management*. 2015;**30**(1):14–30.
- 13 Strauss A, Corbin J. *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*, 3rd edn. Thousand Oaks, CA, Sage Publications, 1998.
- **14** Deschepper R, Vander Stichele R, Haaijer-Ruskamp F. Cross-cultural differences in lay attitudes and utilisation of antibiotics in a Belgian and a Dutch city. *Patient Education and Counselling*. 2002;**48**:161–9.
- **15** Björnsdóttir I, Holme Hansen E. Telephone prescribing of antibiotics. General practitioners' views and reflections. *European Journal of Public Health*. 2001;**11**:260–3.
- **16** Friend-du Preez N, Cameron N, Griffiths P. 'So they believe that if the baby is sick you must give drugs...'

 The importance of medicines in health-seeking behaviour for childhood illnesses in urban South Africa. *Social Science & Medicine*. 2013;**92**:43–52.
- 17 Chen L-C, Chen T-C, Huang Y-B, Chang C-S. Disease acceptance and adherence to imatinib in Taiwanese chronic myeloid leukaemia outpatients. *International Journal of Clinical Pharmacy*. 2014;36:120–7.
- **18** Holmström I, Bastholm-Rahmner P, Bernsten C, Röing M and Björkman I. Swedish teenagers and over-the-counter analgesics responsible, casual or careless use. *Research in Social and Administrative Pharmacy*. 2014;**10**:408–18.
- **19** Richard C, Lussier M-T. Nature and frequency of exchanges on medications during primary care encounters. *Patient Education & Counselling*. 2006;**64**:207−16.
- **20** Bjerrum L, Larsen J, Søndergaard J. Drug prescription patterns in general practice. Extent, problems and possibilities of improvement. *Ugeskr Laeger*. 2002;**4**:5273–7.
- 21 Kitzinger J. Qualitative research: introducing focus groups. *British Medical Journal*. 1995;311:299–302.

- 2
- **22** Dahlgren L, Emmelin M, Winkvist A. *Qualitative Methodology for International Public Health*. Umeå University: Umeå International School of Public Health, 2004.
- 23 Carter S, Moles R, White L, Chen T. Exploring patients' motivation to participate in Australia's Home Medicines Review program. *International Journal of Clinical Pharmacy*. 2012;34:658–66.
- **24** Latif A, Pollock K, Boardman H. Medicines use reviews: a potential resource or lost opportunity for general practice? *BMC Family Practice*. 2013;**14**:57.
- 25 Hayward J, Thomson F, Milne H, et al. 'Too much, too late': mixed methods multi-channel video recording study of computerized decision support systems and GP prescribing. *Journal of the American Medicine Information Association*. 2013;20:e76–84.
- **26** Savage I. Observing pharmacists at work: quantifying the Hawthorne effect. *Journal of Social and Administrative Pharmacy*. 1996;**13**:8–19.
- **27** Patton MQ. *Qualitative Research and Evaluation Methods*, 3rd edn. Thousand Oaks, CA, Sage Publications, 2002.
- **28** Ritchie J, Lewis J. *Qualitative Research Practice: A Guide for Social Science Students and Researchers*. London, Sage Publications, 2003.
- **29** Miles M, Huberman AM. *Qualitative Data Analysis: A Sourcebook of New Methods*. Thousand Oaks, CA, Sage Publications, 1984.

- **30** Giorgi A. An example of harmony between descriptive reports and behavior. *Journal of Phenomenological Psychology*. 1989;**20**:60–88.
- **31** Guba EG, Lincoln YS. *Fourth Generation Evaluation*. Thousand Oaks, CA, Sage Publications, 1989.
- **32** Hamberg K, Johansson E, Lindgren G, Westman G. Scientific Rigour in qualitative research examples from a study of women's health in family practice. *Family Practice*. 1994;**11**:176–81.
- **33** Malterud K. Qualitative research: standards, challenges, and guidelines. *Lancet*. 2001;**358**:483–8.
- **34** Green J, Willis K, Hughes E, et al. Generating best evidence from qualitative research: the role of data analysis. *Australian and New Zealand Journal of Public Health*. 2007;**31**:545–50.
- **35** Holloway I, Todres L. The status of method: flexibility, consistency and coherence. *Qualitative Research*. 2003;**3**:345–57.
- **36** Greenhalgh T. *How to Read a Paper: The Basics of Evidence-Based Medicine*, 3rd edn. Oxford, Blackwell Publishing, 2006.
- 37 Morgan DL. Integrating Qualitative and Quantitative Methods: A Pragmatic Approach. Thousand Oaks, CA, Sage Publications, 2014.

- **1** Kennedy PJ, Leathley CM, Hughes CF. Clinical practice variation. *Medical Journal of Australia*. 2010;**193**(8 Suppl.):S97–9.
- **2** Bergman U. The history of the Drug Utilization Research Group in Europe. *Pharmacoepidemiology* and Drug Safety. 2006;**15**(2):95–8.
- **3** Carstairs V. Small area analysis and health service research. *Community Medicine*. 1981;**3**(2):131–9.
- **4** Zhang Y, Baicker K, Newhouse JP. Geographic variation in Medicare drug spending. *New England Journal of Medicine*. 2010;**363**(5):405–9.
- **5** Zhang Y, Baicker K, Newhouse JP. Geographic variation in the quality of prescribing. *New England Journal of Medicine*. 2010;**363**(21):1985–8.
- **6** Donohue JM, Morden NE, Gellad WF, Bynum JP, Zhou W, Hanlon JT, et al. Sources of regional variation in Medicare Part D drug spending. *New England Journal of Medicine*. 2012;**366**(6):530–8.
- **7** Arnlind MH, Wettermark B, Nokela M, Hjemdahl P, Rehnberg C, Jonsson EW. Regional variation and adherence to guidelines for drug treatment of asthma. *European Journal of Clinical Pharmacology*. 2010;**66**(2):187–98.
- **8** Piovani D, Clavenna A, Bonati M. Drug use profile in outpatient children and adolescents in different Italian regions. *BMC Pediatrics*. 2013;**13**:46.
- **9** Neovius M, Sundstrom A, Simard J, Wettermark B, Cars T, Feltelius N, et al. Small-area variations in sales of TNF inhibitors in Sweden between 2000 and 2009. *Scandinavian Journal of Rheumatology*. 2011;**40**(1):8–15.
- **10** Palesh M, Jonsson PM, Jamshidi H, Wettermark B, Tomson G, Fredrikson S. Diffusion of interferon beta in Iran and its utilization in Tehran. *Pharmacoepidemiology and Drug Safety*. 2008;**17**(9):934–41.
- 11 Kloos H, Assefa Y, Adugna A, Mulatu MS, Mariam DH. Utilization of antiretroviral treatment in Ethio-

- pia between February and December 2006: spatial, temporal, and demographic patterns. *International Journal of Health Geographics*. 2007;**6**:45.
- **12** Parsons A, Johnstone A. Postcode prescribing and the Human Rights Act 1998. *Journal of the Royal Society of Medicine*. 2001;**94**(4):159–60.
- 13 Vander Stichele RH, Elseviers MM, Ferech M, Blot S, Goossens H. European surveillance of antimicrobial consumption (ESAC): data collection performance and methodological approach. *British Journal of Clinical Pharmacology*. 2004;**58**(4):419–28.
- **14** European Surveillance of Antimicrobial Consumption: ESAC I Final Report. 2004.
- **15** The EURO-MED-STAT Group. EURO-MED-STAT: monitoring expenditure and utilization of medicinal products in the European Union countries: a public health approach. *European Journal of Public Health*. 2003;**13**(3 Suppl.):95–100.
- **16** The Pharmacoepidemiological Research on Outcomes of Therapeutics by a European Consortium (PROTECT) (last accessed 20 December 2015)
- 17 Grimsson A, Idänpään Heikkilä J, Lunde PKM, Olafsson O, Westerholm B. The Utilization of Psychotopic Drugs in Finland, Iceland, Norway and Sweden. Studies in Drug Utilization. WHO Regional Publications. European Series No 8. Copenhagen, World Health Organization, Regional Office for Europe, 1979.
- 18 WHO Drug Utilization Research Group (DURG): Griffiths K, McDevitt DG, Andrew M, Baksaas I, Lunde PK, Bergman U, et al. Validation of observed differences in the utilization of antihypertensive and antidiabetic drugs in Northern Ireland, Norway and Sweden. *European Journal of Clinical Pharmacology*. 1985;29:1–8.
- 19 WHO Drug Utilization Research Group (DURG): Griffiths K, McDevitt DG, Andrew M, Baksaas I, Helgeland A, Jervell J, et al. Therapeutic traditions in Northern Ireland, Norway and Sweden:

- I. Diabetes. European Journal of Clinical Pharmacology. 1986:**30**:513–19.
- 20 WHO Drug Utilization Research Group (DURG): Griffiths K, McDevitt DG, Andrew M, Baksaas I, Helgeland A, Jervell J, et al. Therapeutic traditions in Northern Ireland, Norway and Sweden: II. Hypertension. European Journal of Clinical Pharmacology. 1986;30:521–5.
- 21 Gillström A, Wettermark B. Literature review: cross-national comparison of DU activities. Publication from the European Scientific Meeting of Drug Utilization 'Better Public Health through Pharmacoepidemiology and Quality Use of Medicine', Antwerp, Belgium, 2011.
- **22** Poluzzi E, Raschi E, Koci A, Moretti U, Spina E, Behr ER, et al. Antipsychotics and torsadogenic risk: signals emerging from the US FDA Adverse Event Reporting System database. *Drug Safety*. 2013;**36**(6):467–79.
- **23** Raschi E, Poluzzi E, Godman B, Koci A, Moretti U, Kalaba M, et al. Torsadogenic risk of antipsychotics: combining adverse event reports with drug utilization data across Europe. *PLoS ONE*. 2013;**8**:e81208.
- **24** Poluzzi E, Raschi E, Godman B, Koci A, Moretti U, Kalaba M, et al. Pro-arrythmic potential of oral antihistamines (H1): combining adverse event reports with drug utilization data across Europe. 2015;**10**(3):e0119551.
- **25** Godman B, Shrank W, Andersen M, Berg C, Bishop I, Burkhardt T, et al. Comparing policies to enhance prescribing efficiency in Europe through increasing generic utilisation: changes seen and global implications. *Expert Reviews in Pharmacoeconomics Outcomes Research*. 2010;**10**:707–22.
- 26 Godman B, Shrank W, Andersen M, Berg C, Bishop I, Burkhardt T, et al. Policies to enhance prescribing efficiency in Europe: findings and future implications. *Frontiers in Pharmacology*. 2011;1:1–16.
- **27** Avorn J, Monette J, Lacour A, Bohn RL, Monane M, Mogun H, LeLorier J. Persistence of use of lipid-lowering medications: a cross-national study. *Journal of the American Medical Association*. 1998;**279**:1458–62.
- **28** Jackevicius CA, Tu JV, Ross JS, Ko DT, Krumholz HM. Use of ezetimibe in the United States and Canada. *New England Journal of Medicine*. 2008;**358**:1819–28.
- **29** Oei PL, Ratnam SS. Hormone replacement therapy in the developing countries. *Australian & New Zealand Journal of Obstetrics & Gynaecology*. 1998;**38**(2):141–4.

- **30** Chong MY, Tan CH, Fujii S, Yang SY, Ungvari GS, Si T, et al. Antipsychotic drug prescription for schizophrenia in East Asia: rationale for change. *Psychiatry and Clinical Neurosciences*. 2004;**58**(1):61–7.
- 31 Uchida N, Chong MY, Tan CH, Nagai H, Tanaka M, Lee MS, et al. International study on antidepressant prescription pattern at 20 teaching hospitals and major psychiatric institutions in East Asia: Analysis of 1898 cases from China, Japan, Korea, Singapore and Taiwan. *Psychiatry and Clinical Neurosciences*. 2007;61(5):522–8.
- **32** Chua KL, Soh SE, Ma S, Lee BW. Pediatric asthma mortality and hospitalization trends across Asia Pacific: relationship with asthma drug utilization patterns. *World Allergy Organization Journal*. 2009;**2**(5):77–82.
- **33** Andersen M, Bergman U, Choi NK, Gerhard T, Huang C, Jalbert J, et al. The Asian Pharmacoepidemiology Network (AsPEN): promoting multi-national collaboration for pharmacoepidemiologic research in Asia. *Pharmacoepidemiology and Drug Safety*. 2013;**22**(7):700–4.
- **34** Durán CE, Christiaens T, Acosta Á, Vander Stichele R. Systematic review of cross-national drug utilization studies in Latin America: methods and comparability. *Pharmacoepidemiology and Drug Safety.* 2015. doi: 10.1002/pds.3896.
- **35** Hogerzeil HV, Bimo, Ross-Degnan D, Laing RO, Ofori-Adjei D, Santoso B, et al. Field tests for rational drug use in twelve developing countries. *Lancet*. 1993;**342**(8884):1408–10.
- **36** Borg MA, Zarb P, Ferech M, Goossens H. Antibiotic consumption in southern and eastern Mediterranean hospitals: results from the ARMed project. *Journal of Antimicrobial Chemotherapy*. 2008;**62**(4):830–6.
- 37 Lupattelli A, Spigset O, Twigg MJ, Zagorodnikova K, Mardby AC, Moretti ME, et al. Medication use in pregnancy: a cross-sectional, multinational web-based study. *British Medical Journal Open*. 2014;4(2):e004365.
- **38** Utilization of antiepileptic drugs during pregnancy: comparative patterns in 38 countries based on data from the EURAP registry. *Epilepsia*. 2009;**50**(10):2305–9.
- **39** Ferrer P, Ballarín E, Sabaté M, Laporte JR, Schoonen M, Rottenkolber M, et al. Sources of European drug consumption data at a country level. *International Journal of Public Health*. 2014;**59**(5):877–87.

- 40 Sabaté M, Ferrer P, Ballarín E, Rottenkolber M, Amelio J, Schmiedl S, et al.; PROTECT Work Package 2. Inpatient drug utilization in Europe: nationwide data sources and a review of publications on a selected group of medicines (PROTECT Project). Basic Clinical Pharmacology & Toxicology. 2015;116(3):201–11.
- **41** Vander Stichele RH, Peys F, Van Tielen R, Van Eeckhout H, van Essche O, Seys B. A decade of growth in public and private pharmaceutical expenditures: the case of Belgium 1990–1999. *Acta Clinica Belgica*. 2003;**58**(5):279–89; disc. 7–8.
- **42** Jonsson B, Kobelt G, Smolen J. The burden of rheumatoid arthritis and access to treatment: uptake of new therapies. *European Journal of Health Economics*. 2008;**8**(Suppl. 2):S61–86.
- **43** Molstad S, Lundborg CS, Karlsson AK, Cars O. Antibiotic prescription rates vary markedly between 13 European countries. *Scandinavian Journal of Infectious Diseases*. 2002;**34**(5):366–71.
- **44** Walley T, Folino-Gallo P, Stephens P, Van Ganse E. Trends in prescribing and utilization of statins and other lipid lowering drugs across Europe 1997–2003. *British Journal of Clinical Pharmacology*. 2005;**60**(5):543–51.
- **45** Neubert A, Verhamme K, Murray ML, Picelli G, Hsia Y, Sen FE, et al. The prescribing of analgesics and non-steroidal anti-inflammatory drugs in paediatric primary care in the UK, Italy and the Netherlands. *Pharmacological Research.* 2010;**62**(3):243–8.
- **46** Obradovic M, Mrhar A, Kos M. Market uptake of biologic and small-molecule targeted oncology drugs in Europe. *Clinical Therapeutics*. 2009;**31**(12):2940–52.
- **47** Hoebert JM, Mantel-Teeuwisse AK, van Dijk L, Laing RO, Leufkens HG. Quality and completeness of utilisation data on biological agents across European countries: tumour necrosis factor alpha inhibitors as a case study. *Pharmacoepidemiology and Drug Safety*. 2011;**20**(3):265–71.
- **48** Walley T, Folino-Gallo P, Schwabe U, Van Ganse E, Stephens P. Comparison of national administrative and commercial databases to monitor expenditure and costs of statins across Europe. *European Journal of Clinical Pharmacology*. **2004**;**60**(7):503–11.
- **49** Ronning M, Blix HS, Harbo BT, Strom H. Different versions of the anatomical therapeutic chemical classification system and the defined daily dose are

- drug utilisation data comparable? *European Journal of Clinical Pharmacology*. 2000;**56**(9–10):723–7.
- 50 Ballarín E, Ferrer P, Sabaté M, Petri H, Rottenkolber M, Fortuny J, et al. A proposed checklist to interpret cross-national comparison studies of drug utilization. Available from: http:// www.imi-protect.eu/documents/Ballarinetal-AproposedchecklistICPE2012.pdf (last accessed 18 November 2015).
- **51** Stolk P, Van Wijk BL, Leufkens HG, Heerdink ER. Between country variation in the utilization of antihypertensive agents: guidelines and clinical practice. *Journal of Human Hypertension*. 2006;**20**:917–22.
- **52** Deschepper R, Grigoryan L, Lundborg CS, Hofstede G, Cohen J, Van Der Kelen G, et al. Are cultural dimensions relevant for explaining cross-national differences in antibiotic use in Europe? *BMC Health Services Research.* 2008;**8**:123.
- **53** Ferrer P, Raffaniello C, Sabaté M, Ballarín E, Coma A, Corinne Z. Cross-national comparison of antiepileptic drug use: Catalonia, Denmark and Norway, 2007–2011. *Epidemiology Biostatistics and Public Health*. 2014;**11**(3).
- **54** Marshall MN, Shekelle PG, McGlynn EA, Campbell S, Brook RH, Roland MO. Can health care quality indicators be transferred between countries? *Quality & Safety in Health Care*. 2003;**12**:8−12.
- 55 Hoven JL, Haaijer-Ruskamp FM, Vander Stichele RH. Indicators of prescribing quality in drug utilisation research: report of a European meeting (DUR-QUIM, 13–15 May 2004). *European Journal of Clinical Pharmacology*. 2005;60(11):831–4.
- 56 EURO-MED-STAT Group. EURO-MED-STAT: Recommendations for National Registers of Medicinal Products with Validated ATC Codes and DDD Values. Final version, March 2004.
- 57 Furu K, Wettermark B, Andersen M, Martikainen JE, Almarsdottir AB, Sorensen HT. The Nordic countries as a cohort for pharmacoepidemiological research. *Basic & Clinical Pharmacology & Toxicology*. 2010;106(2):86−94.
- 58 Wettermark B, Zoega H, Furu K, Korhonen M, Hallas J, Norgaard M, et al. The Nordic prescription databases as a resource for pharmacoepidemiological research a literature review. *Pharmacoepidemiology and Drug Safety*. 2013;22(7):691–9.

- 59 Wirtz VJ, Reich MR, Leyva-Flores R, Dreser A. Medicines in Mexico, 1990-2004: systematic review of research on access and use. Salud Pública de Mexico. 2008;**50**(Suppl. 4):S470-9.
- 60 Mousavi S, Mansouri A, Jahangard-Rafsanjani Z, Sarayani A, Hadjibabaie M, Gholami K. Biblio-

graphic search of publication patterns in rational use of drugs in Iran: a systematic approach. Acta Medica Iranica. 2014;52(1):76-81.

- 1 Godman B, Shrank W, Andersen M, Berg C, Bishop I, Burkhardt T, et al. Policies to enhance prescribing efficiency in europe: findings and future implications. *Frontiers in Pharmacology*. 2010;1:141.
- 2 Hoffman JM, Li E, Doloresco F, Matusiak L, Hunkler RJ, Shah ND, et al. Projecting future drug expenditures in U.S. nonfederal hospitals and clinics 2013. *American Journal of Health System Pharmacy*. 2013;**70**(6):525–39.
- **3** Pharmaceutical Health Information System. PHIS Hospital Pharma Report. Austria, 2010.
- **4** Wood R, Stirling A, Nolan C, Chalmers J, Blair M. Trends in the coverage of 'universal' child health reviews: observational study using routinely available data. *British Medical Journal Open*. 2012;**2**(2):e000759.
- **5** OECD health statistics: http://stats.oecd.org/index. aspx?DataSetCode=HEALTH_STAT# (last accessed 18 November 2015).
- **6** World Health Organization. Health Topics: Hospitals 2014. Available from: http://www.who.int/topics/hospitals/en/ (last accesed 18 November 2015).
- **7** Davey P, Brown E, Fenelon L, Finch R, Gould I, Hartman G, et al. Interventions to improve antibiotic prescribing practices for hospital inpatients. *Cochrane Database of Systematic Reviews*. 2005(4):CD003543.
- **8** Halter M, Drennan V, Chattopadhyay K, Carneiro W, Yiallouros J, de Lusignan S, et al. The contribution of physician assistants in primary care: a systematic review. *BMC Health Services Research*. 2013;**13**:223–.
- **9** Gruen RL, Weeramanthri TS, Knight SE, Bailie RS. Specialist outreach clinics in primary care and rural hospital settings. *Cochrane Database Of Systematic Reviews*. 2004(1):CD003798.
- **10** Pharmacoepidemiological Research on Outcomes of Therapeutics by a European ConsorTium (PRO-

- TECT). Drug Consumption Databases in Europe. London, 2013.
- **11** Beaulieu M-D, Rioux M, Rocher G, Samson L, Boucher L. Family practice: professional identity in transition. A case study of family medicine in Canada. *Social Science & Medicine*, 2008;**67**(7):1153–63.
- **12** Halvorsen JG. Perspective: united we stand, divided we fall: the case for a single primary care specialty in the United States. *Academic Medicine*. 2008;**83**(5):425–31.
- **13** Matsumoto M, Inoue K, Farmer J, Inada H, Kajii E. Geographic distribution of primary care physicians in Japan and Britain. *Health & Place*. 2010;**16**(1):164–6.
- **14** Moosa S, Downing R, Mash B, Reid S, Pentz S, Essuman A. Understanding of family medicine in Africa: a qualitative study of leaders' views. *British Journal of General Practice*. 2013;**63**(608):e209–16.
- 15 Oleszczyk M, Svab I, Seifert B, Krztoń-Królewiecka A, Windak A. Family medicine in post-communist Europe needs a boost. Exploring the position of family medicine in healthcare systems of Central and Eastern Europe and Russia. *BMC Family Practice*. 2012;13:15–.
- **16** Ventres WB. The emergence of primary care in Latin America: reflections from the field. *Journal of the American Board of Family Medicine*. 2013;**26**(2):183–6.
- 17 Hoffman JM, Li E, Doloresco F, Matusiak L, Hunkler RJ, Shah ND, et al. Projecting future drug expenditures 2012. *American Journal of Health System Pharmacy*. 2012;**69**(5):405–21.
- **18** Yu X, Li C, Shi Y, Yu M. Pharmaceutical supply chain in China: current issues and implications for health system reform. *Health Policy*. 2010;**97**(1):8–15.
- **19** Tarn YH, Hu S, Kamae I, Yang BM, Li SC, Tangcharoensathien V, et al. Health-care systems and pharmacoeconomic research in Asia-Pacific region. *Value in Health*. 2008;**11**(Suppl. 1):S137–55.

- **20** Sun Q, Santoro MA, Meng Q, Liu C, Eggleston K. Pharmaceutical policy in China. *Health Affairs*. 2008;**27**(4):1042–50.
- **21** Berdot S, Gillaizeau F, Caruba T, Prognon P, Durieux P, Sabatier B. Drug administration errors in hospital inpatients: a systematic review. *PLoS ONE*. 2013;**8**(6):e68856.
- **22** Khan LM. Comparative epidemiology of hospital-acquired adverse drug reactions in adults and children and their impact on cost and hospital stay a systematic review. *European Journal of Clinical Pharmacology*. 2013;**69**(12):1985–96.
- **23** Kongkaew C, Noyce PR, Ashcroft DM. Hospital admissions associated with adverse drug reactions: a systematic review of prospective observational studies. *Annals of Pharmacotherapy*. 2008;**42**(7):1017–25.
- **24** Winterstein AG, Sauer BC, Hepler CD, Poole C. Preventable drug-related hospital admissions. *Annals of Pharmacotherapy*. 2002;**36**(7–8):1238–48.
- **25** Langner I, Selke GW. *Arzneitherapie (Gut beraten klug verordnen)*. Berlin, Wissenschaftliches Institut der AOK. 2011.
- **26** Pehe C. Pharmaceutical check a paradigm of AOK Rheinland/Hamburg for the securing of the safety of pharmacotherapy. 20th Annual Meeting of the German Drug Utilisation Research Group (GAA), Düsseldorf, 2013.
- 27 Hurding S, MacBride-Stewart S. National Therapeutic Indicators 2013 – Baseline Report. Edinburgh, 2013.
- **28** Instituut voor Verantwoord Medicijngebruik, Dutch Institute for Rational Use of Medicine. Monitor Voorschrijfgedrag Huisartsen. The Netherlands, 2013.
- 29 All Wales Medicines Strategy Group. National Prescribing Indicators 2014–2015. Wales, 2014.
- 30 Health and Social Care Information Centre. QIPP Prescribing Comparators (2013/14). England, 2013.
- **31** Swedish Association of Local Authorities and Regions. Quality and Efficiency in Swedish Health Care. Sweden, 2010.
- **32** National Prescribing Services Ltd. Indicators of Quality Prescribing in Australian General Practice. Australia, 2006.
- **33** Sandhu SK, Chu J, Yurkovich M, Harriman D, Taraboanta C, Fitzgerald JM. Variations in the management of acute exacerbations of chronic obstructive pulmonary disease. *Canadian Respiratory Journal*. 2013;**20**(3):175–9.

- **34** Wijayaratne K, Wilson J, Sivakumaran P, Sriram KB. Differences in care between general medicine and respiratory specialists in the management of patients hospitalized for acute exacerbations of chronic obstructive pulmonary disease. *Annals of Thoracic Medicine*. 2013;**8**(4):197–203.
- **35** Nawata S, Yamauchi K, Ikegami N. Factors related to prescription dosage in Japanese psychiatric hospitals. *Psychiatry and Clinical Neurosciences*. 2005;**59**(1):70–6.
- **36** Plet H, Hallas J, Kjeldsen L. Adherence to hospital drug formularies and cost of drugs in hospitals in Denmark. *European Journal of Clinical Pharmacology*. 2013;**69**(10):1837–43.
- 37 Hjerpe P, Ohlsson H, Lindblad U, Boström KB, Merlo J. Understanding adherence to therapeutic guidelines: a multilevel analysis of statin prescription in the Skaraborg Primary Care Database. *European Journal of Clinical Pharmacology*. 2011;67(4):415–23.
- **38** Bjerrum L, Bergman U. Wide variation in the number of different drugs prescribed by general practitioners: a prescription database study. *Scandinavian Journal of Primary Health Care*. 2000;**18**(2):94–8.
- **39** Reshetko OV, Furman NV, Magdeev RM. The structure of drug prescription in acute coronary syndrome without ST segment elevation on the first day of hospital therapy. *Rational Pharmacotherapy in Cardiology*. 2009;**2**:8–17.
- **40** Gendel I, Azzam ZS, Braun E, Levy Y, Krivoy N. Antibiotic utilization prevalence: prospective comparison between two medical departments in a tertiary care university hospital. *Pharmacoepidemiology and Drug Safety.* **2004**;**13**(10):735–9.
- **41** Vlahović-Palčevski V, Dumpis U, Mitt P, Gulbinovič J, Struwe J, Palčevski G, et al. Benchmarking antimicrobial drug use at university hospitals in five European countries. *Clinical Microbiology and Infection*. 2007;**13**(3):277–83.
- **42** Wettermark B, Pehrsson A, Jinnerot D, Bergman U. Drug utilisation 90% profiles a useful tool for quality assessment of prescribing in primary health care in Stockholm. *Pharmacoepidemiology and Drug Safety*. 2003;**12**(6):499–510.
- **43** Coste J, Venot A. An epidemiologic approach to drug prescribing quality assessment: a study in primary care practice in France. *Medical Care*. 1999;**37**(12):1294–307.

- **44** Eguale T, Buckeridge DL, Winslade NE, Benedetti A, Hanley JA, Tamblyn R. Drug, patient, and physician characteristics associated with off-label prescribing in primary care. *Archives of Internal Medicine*. 2012;**172**(10):781–8.
- 45 Guthrie B, McCowan C, Davey P, Simpson CR, Dreischulte T, Barnett K. High risk prescribing in primary care patients particularly vulnerable to adverse drug events: cross sectional population database analysis in Scottish general practice. *British Medical Journal (Overseas & Retired Doctors Edition)*. 2011;342:d3514.
- **46** Schaff RL, Schumock GT, Nadzam DM. Development of the Joint Commission's indicators for monitoring the medication use system. *Hospital Pharmacy*. 1991;**26**(4):326–9.
- **47** NSW Therapeutic Advisory Group Inc. Indicators for Quality Use of Medicines in Australian Hospitals. Darlinghurst, 2007.
- **48** Al-Mohamadi A, Al-Harbi AM, Manshi AM, Rak-kah MM. Medications prescribing pattern toward insured patients. *Saudi Pharmaceutical Journal*. 2014;**22**(1):27–31.
- **49** Visca M, Donatini A, Gini R, Federico B, Damiani G, Francesconi P, et al. Group versus single handed primary care: a performance evaluation of the care delivered to chronic patients by Italian GPs. *Health Policy*. 2013;**113**(1–2):188–98.
- **50** Rashed AN, Neubert A, Tomlin S, Jackman J, Alhamdan H, AlShaikh A, et al. Epidemiology and potential associated risk factors of drug-related problems in hospitalised children in the United Kingdom and Saudi Arabia. *European Journal of Clinical Pharmacology*. 2012;**68**(12):1657–66.
- **51** Simon D, Detournay B, Eschwege E, Bouée S, Bringer J, Attali C, et al. Use of vildagliptin in management of type 2 diabetes: effectiveness, treatment persistence and safety from the 2-year real-life VILDA study. *Diabetes Therapy*. 2014;**5**(1):207–24.
- **52** Priest P, Yudkin P, McNulty C, Mant D. Antibacterial prescribing and antibacterial resistance in English general practice: cross sectional study. *British Medical Journal (Clinical Research Edition)*. 2001;**323**(7320):1037–41.
- 53 Maison P, Desamericq G, Hemery F, Elie N, Del'volgo A, Dubois-Randé JL, et al. Relationship between

- recommended chronic heart failure treatments and mortality over 8 years in real-world conditions: a pharmacoepidemiological study. *European Journal of Clinical Pharmacology*. 2013;**69**(4):901–8.
- **54** Fortin-Pellerin E, Petersen C, Lefebvre F, Barrington KJ, Janvier A. Evolving neonatal steroid prescription habits and patient outcomes. *Acta Paediatrica*. 2013;**102**(8):799–804.
- 55 Chang AM, Ho JCS, Yan BP, Yu CM, Lam YY, Lee VWY. Cost-effectiveness of dabigatran compared with warfarin for stroke prevention in patients with atrial fibrillation a real patient data analysis in a Hong Kong teaching hospital. *Clinical Cardiology*. 2013;36(5):280–5.
- **56** Tamblyn R, McLeod P, Hanley JA, Girard N, Hurley J. Physician and practice characteristics associated with the early utilization of new prescription drugs. *Medical Care*. **2003**;**41**(8):895–908.
- 57 Dybdahl T, Andersen M, Kragstrup J, Kristiansen IS, Sondergaard J. General practitioners' adoption of new drugs and previous prescribing of drugs belonging to the same therapeutic class: a pharmacoepidemiological study. *British Journal of Clinical Pharmacology*. 2005;60(5):526–33.
- **58** Ohlsson H, Chaix B, Merlo J. Therapeutic traditions, patient socioeconomic characteristics and physicians' early new drug prescribing a multilevel analysis of rosuvastatin prescription in south Sweden. *European Journal of Clinical Pharmacology*. 2009;**65**(2):141–50.
- **59** Pichetti S, Sermet C, Godman B, Campbell SM, Gustafsson LL. Multilevel analysis of the influence of patients' and general practitioners' characteristics on patented versus multiple-sourced statin prescribing in France. *Applied Health Economics and Health Policy*. 2013;**11**(3):205–18.
- **60** Schwabe U, Paffrath D. (eds.) Arzneiverordnungs-Report 2013. Springer eBooks, 2013.
- 61 All Wales Medicines Strategy Group. Therapeutic Priorities and Clinical Effectiveness Prescribing Programme Summary 2014–2015.
- **62** Zagorodnikova K, Goryachkina K. Clinical Studies on Drug Treatment of Hospitalised Patients: General Infectious Diseases and Acute Myocardial Infarction. Huddinge, Karolinska Institutet, 2013.

- **1** Hansel TT, Barnes PJ. Tiotropium bromide: a novel once-daily anticholinergic bronchodilator for the treatment of COPD. *Drugs of Today*. 2002;**38**(9):585–600.
- **2** Walley T, Folino-Gallo P, Stephens P, Van Ganse E. Trends in prescribing and utilization of statins and other lipid lowering drugs across Europe 1997–2003. *British Journal of Clinical Pharmacology*. 2005;**60**(5):543–51.
- **3** French Health Authority. Report on Efficacy and Effectiveness of Lipid-Lowering Agents. Analyses Focused on Statins. French Health Authority, 2009.
- **4** Maggini M, Raschetti R, Traversa G, Bianchi C, Caffari B, Da Cas R, et al. The cerivastatin withdrawal crisis: a 'post-mortem' analysis. *Health Policy*. 2004;**69**(2):151–7.
- 5 Global Initiative for Asthma. Global Strategy for Asthma Management and Prevention. GINA Report. 2014. Available from: http://www.ginasthma.org/ local/uploads/files/GINA_Report_2015_Aug11.pdf (last accessed 18 November 2015).
- **6** Barnes PJ. Theophylline. *American Journal of Respiratory and Critical Care Medicine*. 2013;**188**(8):901–6.
- **7** Scandinavian Simvastatin Survival Study Group. Randomised trial of cholesterol lowering in 4444 patients with coronary heart disease: the Scandinavian Simvastatin Survival Study (4S). *Lancet*. 1994;**344**(8934):1383–9.
- 8 European Medicines Agency. European Medicines Agency recommends withdrawal of dextropropoxyphene-containing medicines. 2009. Available from: http://www.ema.europa.eu/ema/index.jsp?curl=pages/news_and_events/news/2009/11/news_detail_000074.sjsp (last accessed 18 November 2015).

- **9** Hsiao FY, Tsai YW, Huang WF. Changes in physicians' practice of prescribing cyclooxygenase-2 inhibitor after market withdrawal of rofecoxib: a retrospective study of physician-patient pairs in Taiwan. *Clinical Therapeutics*. 2009;**31**(11):2618–27.
- 10 Sun SX, Lee KY, Bertram CT, Goldstein JL. Withdrawal of COX-2 selective inhibitors rofecoxib and valdecoxib: impact on NSAID and gastroprotective drug prescribing and utilization. *Current Medical Research and Opinion*. 2007;23(8):1859–66.
- 11 Wurst KE, Poole C, Ephross SA, Olshan AF. First trimester paroxetine use and the prevalence of congenital, specifically cardiac, defects: a meta-analysis of epidemiological studies. *Birth Defects Research A Clinical and Molecular Teratology*. 2010;88(3):159–70.
- 12 Bobo WV, Epstein RA, Jr., Hayes RM, Shelton RC, Hartert TV, Mitchel E, et al. The effect of regulatory advisories on maternal antidepressant prescribing, 1995–2007: an interrupted time series study of 228 876 pregnancies. *Archives of Women's Mental Health*. 2014;17(1):17–26.
- 13 Damiani G, Federico B, Anselmi A, Bianchi CB, Silvestrini G, Iodice L, et al. The impact of regional co-payment and national reimbursement criteria on statins use in Italy: an interrupted time-series analysis. *BMC Health Services Research*. 2014;14:6.
- **14** Hynd A, Roughead EE, Preen DB, Glover J, Bulsara M, Semmens J. The impact of co-payment increases on dispensings of government-subsidised medicines in Australia. *Pharmacoepidemiology & Drug Safety.* 2008;**17**(11):1091–9.
- **15** Armour C, Bosnic-Anticevich S, Brillant M, Burton D, Emmerton L, Krass I, et al. Pharmacy Asthma Care Program (PACP) improves outcomes for patients in the community. *Thorax*. 2007;**62**(6):496–502.
- **16** Bunting BA, Cranor CW. The Asheville Project: long-term clinical, humanistic, and economic out-

- comes of a community-based medication therapy management program for asthma. *Journal of the American Pharmacists Association*. 2006;**46**(2):133–47.
- 17 Goossens H, Ferech M, Vander Stichele R, Elseviers M. Outpatient antibiotic use in Europe and association with resistance: a cross-national database study. *Lancet*. 2005;365(9459):579–87.
- **18** Sabuncu E, David J, Bernede-Bauduin C, Pepin S, Leroy M, Boelle PY, et al. Significant reduction of antibiotic use in the community after a nationwide campaign in France, 2002–2007. *PLoS Medicine*. 2009;**6**(6):e1000084.
- 19 Redshaw CH, Stahl-Timmins WM, Fleming LE, Davidson I, Depledge MH. Potential changes in disease patterns and pharmaceutical use in response to climate change. *Journal of Toxicology & Environmental Health B Critical Reviews*. 2013;16(5):285–320.
- **20** Yang BM, Prescott N, Bae EY. The impact of economic crisis on health-care consumption in Korea. *Health Policy Plan.* 2001;**16**(4):372–85.
- 21 Souliotis K, Papageorgiou M, Politi A, Ioakeimidis D, Sidiropoulos P. Barriers to accessing biologic treatment for rheumatoid arthritis in Greece: the unseen impact of the fiscal crisis the Health Outcomes Patient Environment (HOPE) study. *Rheumatology International*. 2014;34(1):25–33.
- **22** Economou M, Madianos M, Peppou LE, Patelakis A, Stefanis CN. Major depression in the era of economic crisis: a replication of a cross-sectional study across Greece. *Journal of Affective Disorders*. 2013;**145**(3):308–14.
- 23 Berger P, Micallef J, Barrau K, Manuel C, Auquier P. [Anti-hepatitis B vaccination: after the health authorities' decision]. *Presse Médicale*. 1999;28(31):1702–6.
- **24** Denis F, Levy-Bruhl D. Mass vaccination against hepatitis B: the French example. *Current Topics in Microbiology & Immunology*. 2006;**304**:115–29.
- 25 Perquin M, Keipes M, Wirion R, Haas N, de Beaufort CE, Michel GH. [Development of the medical treatment of diabetes in Luxembourg]. *Bulletin de la Société des Sciences Médicales du Grand-Duché de Luxembourg*. 2006;1:29–35.
- **26** Kusnik-Joinville O, Weill A, Salanave B, Ricordeau P, Allemand H. Prevalence and treatment of diabetes in France: trends between 2000 and 2005. *Diabetes Metabolism*. 2008;**34**(3):266–72.

- **27** Socan M, Erculj V, Lajovic J. Early detection of influenza like illness through medication sales. *Central European Journal of Public Health*. 2012;**20**(2):156–62.
- **28** Aramini J, Muchaal PK, Pollari F. Value of pharmacy-based influenza surveillance Ontario, Canada, 2009. *Morbidity and Mortality Weekly Report*. 2013;**62**(20):401–4.
- **29** Fuhrman C, Sarter H, Thibaudon M, Delmas MC, Zeghnoun A, Lecadet J, et al. Short-term effect of pollen exposure on antiallergic drug consumption. *Annals of Allergy, Asthma & Immunology.* 2007;**99**(3):225–31.
- **30** Van Ganse E., Harf R., Déchamp C., Clouet F., Daures JP, Jacquier A., et al. *Relationship between Ragweed Pollination Counts and Delivery of Antiallergic Medication*. Stockohlm, European Respiratory Society, 2002.
- **31** Menichini F, Mudu P. Drug consumption and air pollution: an overview. *Pharmacoepidemiology and Drug Safety*. 2010;**19**(12):1300–15.
- 32 Chimonas MA, Gessner BD. Airborne particulate matter from primarily geologic, non-industrial sources at levels below National Ambient Air Quality Standards is associated with outpatient visits for asthma and quick-relief medication prescriptions among children less than 20 years old enrolled in Medicaid in Anchorage, Alaska. *Environmental Research*. 2007;103(3):397–404.
- **33** Vegni FE, Castelli B, Auxilia F, Wilkinson P. Air pollution and respiratory drug use in the city of Como, Italy. *European Journal of Epidemiology*. 2005;**20**(4):351–8.
- **34** Ilyas S, Moncrieff J. Trends in prescriptions and costs of drugs for mental disorders in England, 1998–2010. *British Journal of Psychiatry*. 2012;**200**(5):393–8.
- **35** European Centre for Disease Prevention and Control. *Surveillance of Invasive Bacterial Diseases in Europe, 2011.* Stockholm, European Centre for Disease Prevention and Control, 2013.
- 36 Adriaenssens N, Coenen S, Versporten A, Muller A, Vankerckhoven V, Goossens H. European Surveillance of Antimicrobial Consumption (ESAC): quality appraisal of antibiotic use in Europe. *Journal of Antimicrobial Chemotherapy*. 2011;66(Suppl. 6):vi71–7.
- **37** Adriaenssens N, Coenen S, Versporten A, Muller A, Minalu G, Faes C, et al. European Surveillance of Antimicrobial Consumption (ESAC): outpatient antibiotic use in Europe (1997–2009). *Journal of Antimicrobial Chemotherapy*. 2011;**66**(Suppl. 6):vi3–12.

- **38** Coenen S, Ferech M, Haaijer-Ruskamp FM, Butler CC, Vander Stichele RH, Verheij TJ, et al. European Surveillance of Antimicrobial Consumption (ESAC): quality indicators for outpatient antibiotic use in Europe. *Quality & Safety in Health Care*. 2007;**16**(6):440−5.
- **39** Goossens H, Guillemot D, Ferech M, Schlemmer B, Costers M, van Breda M, et al. National campaigns to improve antibiotic use. *European Journal of Clinical Pharmacology*. 2006;**62**(5):373–9.
- **40** Bauraind I, Lopez-Lozano JM, Beyaert A, Marchal JL, Seys B, Yane F, et al. Association between anti-

- biotic sales and public campaigns for their appropriate use. *Journal of the American Medical Association*. 2004;**292**(20):2468–70.
- **41** Goossens H, Coenen S, Costers M, De Corte S, De Sutter A, Gordts B, et al. Achievements of the Belgian Antibiotic Policy Coordination Committee (BAPCOC). *Euro Surveillance*. 2008;**13**(46). pii: 19036.
- **42** Adriaenssens N, Coenen S, Muller A, Vankerckhoven V, Goossens H. European Surveillance of Antimicrobial Consumption (ESAC): outpatient systemic antimycotic and antifungal use in Europe. *Journal of Antimicrobial Chemotherapy*. 2010;**65**(4):769–74.

- 1 Kearns GL, Abdel-Rahman SM, Alander SW, Blowey DL, Leeder JS, Kauffman RE. Developmental pharmacology drug disposition, action, and therapy in infants and children. *New England Journal of Medicine*. 2003;**349**(12):1157–67.
- **2** Mangoni AA, Jackson SH. Age-related changes in pharmacokinetics and pharmacodynamics: basic principles and practical applications. *British Journal of Clinical Pharmacology*. 2004;**57**(1):6–14.
- 3 Van Spall HC, Toren A, Kiss A, Fowler RA. Eligibility criteria of randomized controlled trials published in high-impact general medical journals: a systematic sampling review. *Journal of the American Medical Association*. 2007;**297**(11):1233–40.
- **4** Johnson RE, Mullooly JP, Greenlick MR. Morbidity and medical care utilization of old and very old persons. *Health Services Research*. 1990;**25**(4):639–65.
- **5** Xu KT. Financial disparities in prescription drug use between elderly and nonelderly Americans. *Health Affairs (Project Hope)*. 2003;**22**(5):210–21.
- **6** Maison P, Cunin P, Hemery F, Fric F, Elie N, Del'volgo A, et al. Utilisation of medications recommended for chronic heart failure and the relationship with annual hospitalisation duration in patients over 75 years of age: a pharmacoepidemiological study. *European Journal of Clinical Pharmacology*. 2005;**61**(5–6):445–51.
- **7** Kvan E, Pettersen KI, Landmark K, Reikvam A. Treatment with statins after acute myocardial infarction in patients > or = 80 years: underuse despite general acceptance of drug therapy for secondary prevention. *Pharmacoepidemiology and Drug Safety.* 2006;**15**(4):261–7.
- **8** Wastesson JW, Parker MG, Fastbom J, Thorslund M, Johnell K. Drug use in centenarians compared with nonagenarians and octogenarians in Sweden:

- a nationwide register-based study. *Age and Ageing*. 2012;**41**(2):218–24.
- **9** Maust DT, Oslin DW, Marcus SC. Effect of age on the profile of psychotropic users: results from the 2010 National Ambulatory Medical Care Survey. *Journal of the American Geriatrics Society*. 2014;**62**(2):358–64.
- **10** Athanasopoulos C, Pitychoutis PM, Messari I, Lionis C, Papadopoulou-Daifoti Z. Is drug utilization in Greece sex dependent? A population-based study. *Basic & Clinical Pharmacology & Toxicology*. 2013;**112**(1):55–62.
- 11 Manteuffel M, Williams S, Chen W, Verbrugge RR, Pittman DG, Steinkellner A. Influence of patient sex and gender on medication use, adherence, and prescribing alignment with guidelines. *Journal of Women's Health*. 2014;23(2):112–19.
- 12 Loikas D, Wettermark B, von Euler M, Bergman U, Schenck-Gustafsson K. Differences in drug utilisation between men and women: a cross-sectional analysis of all dispensed drugs in Sweden. *British Medical Journal Open.* 2013;3(5).
- 13 Regitz-Zagrosek V, ed. Sex and Gender Differences in Pharmacology. Rotterdam, Springer, 2012.
- 14 Barford A, Dorling D, Davey Smith G, Shaw M. Life expectancy: women now on top everywhere. British Medical Journal (Clinical Research Edition). 2006;332(7545):808.
- **15** Olsen KM, Dahl SA. Health differences between European countries. *Social Science & Medicine*. 2007;**64**(8):1665–78.
- **16** Schenck-Gustafsson K, ed. *Handbook of Clinical Gender Medicine*. Basel, Karger, 2012.
- 17 McHugh RK, Whitton SW, Peckham AD, Welge JA, Otto MW. Patient preference for psychological vs pharmacologic treatment of psychiatric disorders: a meta-analytic review. *Journal of Clinical Psychiatry*. 2013;74(6):595–602.

- **18** Empereur F, Baumann M, Alla F, Briancon S. Factors associated with the consumption of psychotropic drugs in a cohort of men and women aged 50 and over. *Journal of Clinical Pharmacy and Therapeutics*. 2003;**28**(1):61–8.
- **19** Vaidya V, Partha G, Karmakar M. Gender differences in utilization of preventive care services in the United States. *Journal of Women's Health*. 2012;**21**(2):140–5.
- **20** Pinkhasov RM, Wong J, Kashanian J, Lee M, Samadi DB, Pinkhasov MM, et al. Are men shortchanged on health? Perspective on health care utilization and health risk behavior in men and women in the United States. *International Journal of Clinical Practice*. 2010;**64**(4):475–87.
- **21** Tabenkin H, Goodwin MA, Zyzanski SJ, Stange KC, Medalie JH. Gender differences in time spent during direct observation of doctor-patient encounters. *Journal of Women's Health*. 2004;**13**(3):341–9.
- **22** Banks I, Baker P. Men and primary care: improving access and outcomes. *Trends in Urology & Men's Health*. 2013;**4**(5):39–41.
- **23** Landmark CJ, Fossmark H, Larsson PG, Rytter E, Johannessen SI. Prescription patterns of antiepileptic drugs in patients with epilepsy in a nation-wide population. *Epilepsy Research*. 2011;95(1–2):51–9.
- **24** Crawford PM. Managing epilepsy in women of childbearing age. *Drug Safety*. 2009;**32**(4):293–307.
- **25** Bucholz EM, Butala NM, Rathore SS, Dreyer RP, Lansky AJ, Krumholz HM. Sex differences in long-term mortality after myocardial infarction: a systematic review. *Circulation*. 2014;**130**(9):757–67.
- **26** Khan NA, Daskalopoulou SS, Karp I, Eisenberg MJ, Pelletier R, Tsadok MA, et al. Sex differences in acute coronary syndrome symptom presentation in young patients. *Journal of the American Medical Assocation: Internal Medicine*. 2013;**173**(20):1863–71.
- **27** Robison RJ, Reimherr FW, Marchant BK, Faraone SV, Adler LA, West SA. Gender differences in 2 clinical trials of adults with attention-deficit/hyperactivity disorder: a retrospective data analysis. *Journal of Clinical Psychiatry*. 2008;**69**(2):213–21.
- 28 Kovess-Masfety V, Boyd A, van de Velde S, de Graaf R, Vilagut G, Haro JM, et al. Are there gender differences in service use for mental disorders across countries in the European Union? Results from the EU-World Mental Health survey. *Journal of Epidemiology and Community Health*. 2014;68(7):649–56.

- **29** Klungel OH, de Boer A, Paes AH, Seidell JC, Bakker A. Sex differences in antihypertensive drug use: determinants of the choice of medication for hypertension. *Journal of Hypertension*. 1998;**16**(10): 1545–53.
- **30** Essebag V, Reynolds MR, Hadjis T, Lemery R, Olshansky B, Buxton AE, et al. Sex differences in the relationship between amiodarone use and the need for permanent pacing in patients with atrial fibrillation. *Archives of Internal Medicine*. 2007;**167**(15):1648–53.
- 31 Hippisley-Cox J, Coupland C. Unintended effects of statins in men and women in England and Wales: population based cohort study using the QResearch database. *British Medical Journal (Clinical Research Edi*tion). 2010;340:c2197.
- **32** Roden DM. Drug-induced prolongation of the QT interval. *New England Journal of Medicine*. 2004;**350**(10):1013–22.
- 33 Journath G, Hellenius ML, Petersson U, Theobald H, Nilsson PM. Sex differences in risk factor control of treated hypertensives: a national primary healthcare-based study in Sweden. *European Journal of Cardiovascular Prevention and Rehabilitation*. 2008;15(3):258–62.
- **34** Schwartz JB. The current state of knowledge on age, sex, and their interactions on clinical pharmacology. *Clinical Pharmacology and Therapeutics*. 2007;**82**(1):87–96.
- **35** Wettermark B, Persson A, von Euler M. Secondary prevention in a large stroke population: a study of patients' purchase of recommended drugs. *Stroke*. 2008;**39**(10):2880–5.
- 36 Camm AJ, Lip GY, De Caterina R, Savelieva I, Atar D, Hohnloser SH, et al. 2012 focused update of the ESC Guidelines for the management of atrial fibrillation: an update of the 2010 ESC Guidelines for the management of atrial fibrillation. Developed with the special contribution of the European Heart Rhythm Association. *European Heart Journal*. 2012;33(21):2719–47.
- **37** Salokangas RK. Gender and the use of neuroleptics in schizophrenia. *Schizophrenia Research*. 2004;**66**(1):41–9.
- **38** Gu Q, Burt VL, Paulose-Ram R, Dillon CF. Gender differences in hypertension treatment, drug utilization patterns, and blood pressure control among US adults with hypertension: data from the National Health

- and Nutrition Examination Survey 1999–2004. *American Journal of Hypertension*. 2008;**21**(7):789–98.
- **39** Helfand BT, Evans RM, McVary KT. A comparison of the frequencies of medical therapies for overactive bladder in men and women: analysis of more than 7.2 million aging patients. *European Urology*. 2010;**57**(4):586–91.
- **40** Goodman M, Patil U, Steffel L, Avedon J, Sasso S, Triebwasser J, et al. Treatment utilization by gender in patients with borderline personality disorder. *Journal of Psychiatric Practice*. 2010;**16**(3):155–63.
- **41** von Soest T, Bramness JG, Pedersen W, Wichstrom L. The relationship between socio-economic status and antidepressant prescription: a longitudinal survey and register study of young adults. *Epidemiology and Psychiatric Sciences*. 2012;**21**(1):87–95.
- **42** Henricson K, Carlsten A, Ranstam J, Rametsteiner G, Stenberg P, Wessling A, et al. Utilisation of codeine and propoxyphene: geographic and demographic variations in prescribing, prescriber and recipient categories. *European Journal of Clinical Pharmacology*. 1999;**55**(8):605–11.
- **43** Henricson K, Stenberg P, Rametsteiner G, Ranstam J, Hanson BS, Melander A. Socioeconomic factors, morbidity and drug utilization an ecological study. *Pharmacoepidemiology and Drug Safety*. 1998;**7**(4):261–7.
- **44** Weitoft GR, Rosen M, Ericsson O, Ljung R. Education and drug use in Sweden a nationwide register-based study. *Pharmacoepidemiology and Drug Safety*. 2008;**17**(10):1020–8.
- **45** Melander E, Nissen A, Henricson K, Merlo J, Molstad S, Kampmann JP, et al. Utilisation of antibiotics in young children: opposite relationships to adult educational levels in Danish and Swedish counties. *European Journal of Clinical Pharmacology*. 2003;**59**(4):331–5.
- **46** Haider SI, Johnell K, Weitoft GR, Thorslund M, Fastbom J. The influence of educational level on polypharmacy and inappropriate drug use: a register-based study of more than 600 000 older people. *Journal of the American Geriatrics Society.* 2009;**57**(1):62–9.
- **47** Liou WS, Hsieh SC, Chang WY, Wu GH, Huang HS, Lee C. Brand name or generic? What are the health professionals prescribed for treating diabetes? A longitudinal analysis of the National Health Insurance reimbursement database. *Pharmacoepidemiology and Drug Safety.* **2013**;**22**(7):752–9.

- **48** Bhopal R. Revisiting race/ethnicity as a variable in health research. *American Journal of Public Health*. 2002;**92**(2):156–7.
- **49** Sproston KA, Pitson LB, Walker E. The use of primary care services by the Chinese population living in England: examining inequalities. *Ethnicity & Health*. 2001;**6**(3–4):189–96.
- **50** Mayberry RM, Mili F, Ofili E. Racial and ethnic differences in access to medical care. *Medical Care Research and Review.* 2000;**57**(Suppl. 1):108–45.
- **51** Fiscella K, Franks P, Doescher MP, Saver BG. Disparities in health care by race, ethnicity, and language among the insured: findings from a national sample. *Medical Care*. 2002;**40**(1):52–9.
- **52** Yu SM, Huang ZJ, Singh GK. Health status and health services utilization among US Chinese, Asian Indian, Filipino, and other Asian/Pacific Islander Children. *Pediatrics*. 2004;**113**(1 Pt 1):101–7.
- **53** Quan H, Fong A, De Coster C, Wang J, Musto R, Noseworthy TW, et al. Variation in health services utilization among ethnic populations. *Canadian Medical Association Journal*. 2006;**174**(6):787–91.
- **54** Gaskin DJ, Briesacher BA, Limcangco R, Brigantti BL. Exploring racial and ethnic disparities in prescription drug spending and use among Medicare beneficiaries. *American Journal of Geriatric Pharmacotherapy*. 2006;**4**(2):96–111.
- **55** Jatrana S, Crampton P, Norris P. Ethnic differences in access to prescription medication because of cost in New Zealand. *Journal of Epidemiology and Community Health*. 2011;**65**(5):454–60.
- 56 Bakken K, Melhus M, Lund E. Use of hypnotics in Sami and non-Sami populations in northern Norway. *International Journal of Circumpolar Health*. 2006;65(3):261–70.
- 57 Lesen E, Andersson K, Petzold M, Carlsten A. Socioeconomic determinants of psychotropic drug utilisation among elderly: a national population-based cross-sectional study. *BMC Public Health*. 2010;10:118.
- **58** Pulkki-Raback L, Kivimaki M, Ahola K, Joutsenniemi K, Elovainio M, Rossi H, et al. Living alone and antidepressant medication use: a prospective study in a working-age population. *BMC Public Health*. 2012;**12**:236.
- **59** Nielsen MW, Hansen EH, Rasmussen NK. Patterns of psychotropic medicine use and related diseases across educational groups: national cross-sectional

- survey. European Journal of Clinical Pharmacology. 2004;**60**(3):199–204.
- 60 Stocks NP, Ryan P, McElroy H, Allan J. Statin prescribing in Australia: socioeconomic and sex differences: a cross-sectional study. *Medical Journal of Australia*. 2004;180(5):229–31.
- 61 Brunoni AR, Nunes MA, Figueiredo R, Barreto SM, da Fonseca Mde J, Lotufo PA, et al. Patterns of benzodiazepine and antidepressant use among middle-aged adults. the Brazilian longitudinal study of adult health (ELSA-Brasil). *Journal of Affective Disorders*. 2013;151(1):71–7.
- **62** Opolka JL, Rascati KL, Brown CM, Gibson PJ. Ethnicity and prescription patterns for haloperidol, risperidone, and olanzapine. *Psychiatric Services*. 2004;**55**(2):151–6.
- **63** Hedemalm A, Schaufelberger M, Ekman I. Equality in the care and treatment of immigrants and native Swedes a comparative study of patients hospitalised for heart failure. *European Journal of Cardiovas-cular Nursing*, 2008;**7**(3):222–8.
- 64 Gorecka K, Linhartova A, Vlcek J, Tilser I. Cardiovascular drug utilisation and socio-economic inequalities in 20 districts of the Czech Republic. European Journal of Clinical Pharmacology. 2005;61(5–6):417–23.
- 65 Hamann J, Langer B, Leucht S, Busch R, Kissling W. Medical decision making in antipsychotic drug choice for schizophrenia. *American Journal of Psychiatry*. 2004;161(7):1301–4.
- 66 Christian AH, Mills T, Simpson SL, Mosca L. Quality of cardiovascular disease preventive care and physician/practice characteristics. *Journal of General Internal Medicine*. 2006;21(3):231–7.
- **67** Turchin A, Shubina M, Chodos AH, Einbinder JS, Pendergrass ML. Effect of board certification on antihypertensive treatment intensification in patients with diabetes mellitus. *Circulation*. 2008;**117**(5): 623–8.
- **68** Journath G, Hellenius ML, Manhem K, Kjellgren KI, Nilsson PM. Association of physician's sex with risk factor control in treated hypertensive patients from Swedish primary healthcare. *Journal of Hypertension*. 2008;**26**(10):2050–6.
- **69** Kim C, McEwen LN, Gerzoff RB, Marrero DG, Mangione CM, Selby JV, et al. Is physician gender associated with the quality of diabetes care? *Diabetes Care*. 2005;**28**(7):1594–8.

- **70** Duetz MS, Schneeweiss S, Maclure M, Abel T, Glynn RJ, Soumerai SB. Physician gender and changes in drug prescribing after the implementation of reference pricing in British Columbia. *Clinical Therapeutics*. 2003;**25**(1):273–84.
- 71 Chin MH, Friedmann PD, Cassel CK, Lang RM. Differences in generalist and specialist physicians' knowledge and use of angiotensin-converting enzyme inhibitors for congestive heart failure. *Journal of General Internal Medicine*. 1997;12(9):523–30.
- **72** Ayanian JZ, Hauptman PJ, Guadagnoli E, Antman EM, Pashos CL, McNeil BJ. Knowledge and practices of generalist and specialist physicians regarding drug therapy for acute myocardial infarction. *New England Journal of Medicine*. 1994;**331**(17):1136–42.
- **73** Franks P, Bertakis KD. Physician gender, patient gender, and primary care. *Journal of Women's Health*. 2003;**12**(1):73–80.
- **74** Flocke SA, Gilchrist V. Physician and patient gender concordance and the delivery of comprehensive clinical preventive services. *Medical Care*. 2005;**43**(5):486–92.
- **75** Conway PH, Edwards S, Stucky ER, Chiang VW, Ottolini MC, Landrigan CP. Variations in management of common inpatient pediatric illnesses: hospitalists and community pediatricians. *Pediatrics*. 2006;**118**(2):441–7.
- **76** Choudhry NK, Fletcher RH, Soumerai SB. Systematic review: the relationship between clinical experience and quality of health care. *Annals of Internal Medicine*. 2005;**142**(4):260–73.
- 77 Vancheri F, Strender LE, Montgomery H, Skaner Y, Backlund LG. Coronary risk estimates and decisions on lipid-lowering treatment in primary prevention: comparison between general practitioners, internists, and cardiologists. *European Journal of Internal Medicine*. 2009;20(6):601–6.
- **78** Muth C, Kirchner H, van den Akker M, Scherer M, Glasziou PP. Current guidelines poorly address multimorbidity: pilot of the interaction matrix method. *Journal of Clinical Epidemiology*. 2014;**67**(11):1242–50.
- **79** Fried TR, O'Leary J, Towle V, Goldstein MK, Trentelange M, Martin DK. The effects of comorbidity on the benefits and harms of treatment for chronic disease: a systematic review. *PLoS ONE*. 2014;**9**(11):e112593.

- **80** Pedan A, Varasteh L, Schneeweiss S. Analysis of factors associated with statin adherence in a hierarchical model considering physician, pharmacy, patient, and prescription characteristics. *Journal of Managed Care Pharmacy*. 2007;**13**(6):487–96.
- **81** Egan M, Wolfson C, Moride Y, Monette J. Do patient factors alter the relationship between physician characteristics and use of long-acting benzodiazepines? *Journal of Clinical Epidemiology*. 2000;**53**(11):1181–7.
- **82** Thornton RL, Powe NR, Roter D, Cooper LA. Patient-physician social concordance, medical visit communication and patients' perceptions of health care quality. *Patient Education and Counseling*. 2011;**85**(3):e201–8.
- **83** Jerant A, Bertakis KD, Fenton JJ, Tancredi DJ, Franks P. Patient-provider sex and race/ethnicity concordance: a national study of healthcare and outcomes. *Medical Care*. 2011;**49**(11):1012–20.
- **84** Traylor AH, Schmittdiel JA, Uratsu CS, Mangione CM, Subramanian U. Adherence to cardiovascular disease medications: does patient-provider race/ethnicity and language concordance matter? *Journal of General Internal Medicine*. 2010;**25**(11):1172–7.
- **85** Traylor AH, Schmittdiel JA, Uratsu CS, Mangione CM, Subramanian U. The predictors of patient-physician race and ethnic concordance: a medical facility fixed-effects approach. *Health Services Research*. 2010;**45**(3):792–805.
- **86** McAlearney AS, Oliveri JM, Post DM, Song PH, Jacobs E, Waibel J, et al. Trust and distrust among Appalachian women regarding cervical cancer screening: a qualitative study. *Patient Education and Counseling*, 2012;**86**(1):120–6.
- **87** Ports KA, Barnack-Tavlaris JL, Syme ML, Perera RA, Lafata JE. Sexual health discussions with older

- adult patients during periodic health exams. *Journal of Sexual Medicine*. 2014;**11**(4):901–8.
- **88** Schmittdiel JA, Traylor A, Uratsu CS, Mangione CM, Ferrara A, Subramanian U. The association of patient-physician gender concordance with cardiovascular disease risk factor control and treatment in diabetes. *Journal of Women's Health*. 2009;**18**(12):2065–70.
- **89** Smith GH 3rd. The role of race concordance on prescription drug utilization among primary care case-managed Medicaid enrollees. *Research in Social & Administrative Pharmacy.* 2013;**9**(6):700−18.
- **90** King WD, Wong MD, Shapiro MF, Landon BE, Cunningham WE. Does racial concordance between HIV-positive patients and their physicians affect the time to receipt of protease inhibitors? *Journal of General Internal Medicine*. 2004;**19**(11):1146–53.
- **91** Konrad TR, Howard DL, Edwards LJ, Ivanova A, Carey TS. Physician-patient racial concordance, continuity of care, and patterns of care for hypertension. *American Journal of Public Health*. 2005;**95**(12):2186–90.
- **92** Schoenthaler A, Allegrante JP, Chaplin W, Ogedegbe G. The effect of patient-provider communication on medication adherence in hypertensive black patients: does race concordance matter? *Annals of Behavioral Medicine*. 2012;**43**(3):372–82.
- **93** Schoenthaler A, Montague E, Baier Manwell L, Brown R, Schwartz MD, Linzer M. Patient-physician racial/ethnic concordance and blood pressure control: the role of trust and medication adherence. *Ethnicity & Health*. 2014;**19**(5):565–78.
- **94** Street RL, Jr., O'Malley KJ, Cooper LA, Haidet P. Understanding concordance in patient-physician relationships: personal and ethnic dimensions of shared identity. *Annals of Family Medicine*. 2008;**6**(3):198–205.

- 1 Stated by Dr Barry Bloom, dean of Harvard School of Public Health. Referred to in Johnson JA, Stoskopf C. *Comparative Health Systems: Global Perspectives*. Burlington, MA, Jones & Bartlett, 2010.
- 2 World Health Organization. Monitoring the Building Blocks of Health Systems: A Handbook of Indicators and Their Measurement Strategies. Geneva, World Health Organization, 2010.
- **3** World Health Organization. The World Health Report 2000 Health Systems: Improving Performance. Geneva, World Health Organization, 2000.
- **4** Goodwin N. National health systems: overview. In: van de Beek D, de Gans J, eds. *International Encyclopedia of Public Health*. Amsterdam, Elsevier, 2008: 497–512.
- 5 Egger D, Ollier E. Managing the Health Millennium Development Goals – The Challenge of Management Strengthening: Lessons from Three Countries. Making Health Systems Work: Working Paper No. 8 WHO/HSS/Healthsystems/2007.1. Geneva, Department for Health Policy, Development and Services Health Systems and Services WHO, 2007.
- **6** Marmor T, Wendt C. Conceptual frameworks for comparing healthcare politics and policy. *Health Policy*. 2012;**107**(1):11–20.
- **7** Wendt C, Frisina L, Rothgang H. Healthcare system types: a conceptual framework for comparison. *Social Policy & Administration*, 2009;**43**:70−90.
- 8 Stevens FCJ, van der Zee J. Health system organization models (including targets and goals for health systems). In: Kirch W, ed. *Encyclopedia of Public Health Editors*. Rotterdam, Springer, 2008: 247–56.
- **9** Herrera CA, Rada G, Kuhn-Barrientos L, Barrios X. Does ownership matter? An overview of systematic reviews of the performance of private for-profit, pri-

- vate not-for-profit and public healthcare providers. *PLoS ONE*. 2014;**9**(12):e93456.
- **10** Berwick DM, Nolan TW, Whittington J. The triple aim: care, health, and cost. *Health Affairs (Project Hope)*. 2008;**27**:759–69.
- 11 Shakarishvili G, Lansang MA, Mitta V, Bornemisza O, Blakley M, Kley N, Burgess C, Atun R. Health systems strengthening: a common classification and framework for investment analysis. *Health Policy Plan.* 2011;26(4):316–26.
- 12 Thorpe KE. The rise in health care spending and what to do about it. *Health Affairs*. 2005;24:1436–45.
- 13 Organisation for Economic Co-operation and Development. Health at a Glance 2011: OECD Indicators. Pharmaceutical expenditure. OECD Publishing. Available from: http://www.oecd.org/els/health-systems/49105858.pdf (last accessed 18 November 2015).
- **14** Cameron A, Ewen M, Ross-Degnan D, Ball D, Laing R. Medicine prices, availability, and affordability in 36 developing and middle-income countries: a secondary analysis. *Lancet*. 2009;**373**:240–9.
- 15 Wagner AK, Graves AJ, Reiss SK, Lecates R, Zhang F, Ross-Degnan D. Access to care and medicines, burden of health care expenditures, and risk protection: results from the World Health Survey. *Health Policy*. 2011;100:151–8.
- 16 Bigdeli M, Peters DH, Wagner AK. *Medicines in Health Systems: Advancing Access, Affordability and Appropriate Use.* Geneva, World Health Organization, 2014.
- 17 Godman B, Wettermark B, van Woerkom M, Fraeyman J, Alvarez-Madrazo S, Berg C, et al. Multiple policies to enhance prescribing efficiency for established medicines in Europe with a particular focus on demand-side measures: findings and future implications. *Frontiers in Pharmacology*. 2014;5:106.
- **18** Wettermark B, Jacobsson B, Godman B, Haaijer-Ruskamp F. Soft regulations in pharmaceutical

- policymaking an overview of current approaches and their consequences. *Applied Health Economics and Health Policy*. 2009;**7**:1–11
- 19 Barber SL, Huang B, Santoso B, Laing R, Paris V, Wu C. The reform of the essential medicines system in China: a comprehensive approach to universal coverage. *Journal of Global Health*. 2013;3(1):010303.
- **20** Wagstaff A. Health systems in East Asia: what can developing countries learn from Japan and the Asian Tigers? *Health Economics*. 2007;**16**(5):441–56.
- **21** Laing R, Waning B, Gray A, Ford N, 't Hoen E. 25 years of the WHO essential medicines lists: progress and challenges. *Lancet*. 2003;**361**(9370):1723–9.
- **22** Morden NE, Sullivan SD. States' control of prescription drug spending: a heterogeneous approach. *Health Affairs*. 2005;**24**(4):1032–8.
- 23 WHO 2010. Key components of a well functioning health system. Available from: http://www.who.int/healthsystems/EN_HSSkeycomponents.pdf (last assessed 18 November 2015).
- **24** Lawn J, Rohde J, Rifkin S, Were M, Paul VK, Chopra M. Alma-Ata: rebirth and revision 1. Alma-Ata 30 years on: revolutionary, relevant, and time to revitalize. *Lancet*. 2008;**372**:917–27.
- 25 Holloway KA, Henry D. WHO essential medicines policies and use in developing and transitional countries: an analysis of reported policy implementation and medicines use surveys. *PLoS Medicine*. 2014:11:e1001724.
- **26** Brennan T, Shrank W. New expensive treatments for hepatitis C infection. *Journal of the American Medical Association*. 2014;**312**:593–4.
- 27 Kaplan W, Wirtz V, Mantel-Teeuwisse A, Stolk P, Duthey B, Laing R. Priority Medicines for Europe and the World 2013 Update Report. Available from: http://www.who.int/medicines/areas/priority_medicines/MasterDocJune28_FINAL_Web.pdf?ua (last accessed 18 November 2015).
- 28 Lobato LVC, Giovanella L. Sistemas de Saúde: origens componentes dinâmica. In: Govanella L, Escorel S, Lobato LVC, et al., eds. *Politicas e Sistemas de Saúde no Brasil*. Rio de Janeiro, Fiocruz, 2008: 107–39.
- **29** Nuwer MR. Public policy and healthcare systems. *Handbook of Clinical Neurology.* 2013;**118**:277–87.
- **30** Remme JH, Adam T, Becerra-Posada F, D'Arcangues C, Devlin M, Gardner C, et al. Defining

- research to improve health systems. *PLoS Medicine*. 2010;**7**(11):e1001000.
- 31 Seiter A. A Practical Approach to Pharmaceutical Policy. Washington, DC, World Bank, 2010. Available from: http://www-wds.worldbank.org/external/default/WDSContentServer/IW3P/IB/2010/06/22/000334955_20100622050742/Rendered/PDF/552030PUB0Phar10Box349442B01PUBLIC1.pdf (last accessed 18 November 2015).
- **32** Daemmrich A, Mohanty A. Healthcare reform in the United States and China: pharmaceutical market implications. *Journal of Pharmaceutical Policy Practice*. 2014;**7**(1):9.
- **33** Mansfield SJ. Generic drug prices and policy in Australia: room for improvement? A comparative analysis with England. *Australian Health Review*. 2014;**38**(1):6–15.
- **34** Dylst P, Simoens S. Does the market share of generic medicines influence the price level?: a European analysis. *Pharmacoeconomics*. 2011;**29**:875–82.
- **35** Perriëns JH, Habiyambere V, Dongmo-Nguimfack B, Hirnschall G. Prices paid for adult and paediatric antiretroviral treatment by low- and middle-income countries in 2012: high, low or just right? *Antiviral Therapy*. 2014;**19**(Suppl. 3):39–47.
- **36** Pauwels K, Huys I, Casteels M, Simoens S. Drug shortages in European countries: a trade-off between market attractiveness and cost containment? *BMC Health Services Research*. 2014;**14**:438.
- **37** Downing NS, Aminawung JA, Shah ND, Braunstein JB, Krumholz HM, Ross JS. Regulatory review of novel therapeutics comparison of three regulatory agencies. *New England Journal of Medicine*. 2012;**366**(24):2284–93.
- 38 Packer C, Simpson S, Stevens A; EuroScan: the European Information Network on New and Changing Health Technologies. International diffusion of new health technologies: a ten-country analysis of six health technologies. *International Journal of Technology Assessment in Health Care*. 2006;22:419–28
- **39** Stolk P, Heemstra HE, Leufkens HG, Bloechl-Daum B, Heerdink ER. No difference in between-country variability in use of newly approved orphan and non-orphan medicinal products a pilot study. *Orphanet Journal of Rare Diseases*. 2009;**4**:27.
- **40** Putrik P, Ramiro S, Kvien TK, Sokka T, Pavlova M, Uhligh T, Boonen A; Working Group 'Equity

- in Access to Treatment of Rheumatoid Arthritis in Europe'. Inequities in access to biologic and synthetic DMARDs across 46 European countries. *Annals of the Rheumatic Diseases*. 2014;**73**:198–206.
- **41** Bae G, Bae EY, Bae S. Same drugs, valued differently? Comparing comparators and methods used in reimbursement recommendations in Australia, Canada, and Korea. *Health Policy*. 2015. pii: S0168-8510(15)00027-5.
- **42** Srivastava D, McGuire A. Analysis of prices paid by low-income countries how price sensitive is government demand for medicines? *BMC Public Health*. 2014:**14**:767.
- **43** Masters SH, Burstein R, DeCenso B, Moore K, Haakenstad A, Ikilezi G, et al. Pharmaceutical availability across levels of care: evidence from facility surveys in Ghana, Kenya, and Uganda. *PLoS ONE*. 2014;**9**(12):e114762.
- **44** Mäkinen M, Rautava P, Forsström J, Aärimaa M. Electronic prescriptions are slowly spreading in the European Union. *Telemed Journal of European Health*. 2011;**17**(3):217–22.
- **45** Luffman J. Out-of-pocket spending on prescription drugs. *Statistics Canada*. Catalogue no. 75-001-XIE, 2005.
- **46** Niëns LM, Cameron A, Van de Poel E, Ewen M, Brouwer WB, Laing R. Quantifying the impoverishing effects of purchasing medicines: a cross-country comparison of the affordability of medicines in the developing world. *PLoS Medicine*. 2010;**7**(8):e1000333.
- **47** Wettermark B, Vlahovic-Palcevski V, Laing R, Bergman U. Adherence to WHO's Essential Medicines List in two European countries. *WHO Drug Information*. 2006;**20**:78–85.
- **48** Carlsen B, Kjellberg PK. Guidelines; from foe to friend? Comparative interviews with GPs in Norway and Denmark. *BMC Health Services Research*. 2010;**10**:17.
- **49** Stolk P, Van Wijk BL, Leufkens HG, Heerdink ER. Between-country variation in the utilization of antihypertensive agents: guidelines and clinical practice. *Journal of Human Hypertension*. 2006;**20**(12):917–22.
- 50 McKinlay J, Link C, Marceau L, O'Donnell A, Arber S, Adams A, Lutfey K. How do doctors in different countries manage the same patient? Results of a factorial experiment. *Health Services Research*. 2006;41(6):2182–200.

- 51 Grigoryan L, Burgerhof JG, Degener JE, Deschepper R, Lundborg CS, Monnet DL, et al.; SAR Consortium. Attitudes, beliefs and knowledge concerning antibiotic use and self-medication: a comparative European study. *Pharmacoepidemiology and Drug Safety*. 2007;16:1234–43.
- 52 Grigoryan L, Burgerhof JG, Degener JE, Deschepper R, Lundborg CS, Monnet DL, et al.; Self-Medication with Antibiotics and Resistance (SAR) Consortium. Determinants of self-medication with antibiotics in Europe: the impact of beliefs, country wealth and the healthcare system. *Journal of Antimicrobial Chemotherapy*. 2008;61:1172–9.
- **53** Haak H, Hardon AP. Indigenised pharmaceuticals in developing countries: widely used, widely neglected. *Lancet*. 1988;**2**:620–1.
- **54** Wessling A. Over-the-counter sales of drugs in Sweden 1976–1983. *European Journal of Clinical Pharmacology*. 1987;**33**:1–6.
- 55 Moen J, Antonov K, Larsson CA, Lindblad U, Nilsson JL, Råstam L, Ring L. Factors associated with multiple medication use in different age groups. *Annals of Pharmacotherapy*. 2009;43:1978–85.
- **56** Qato DM, Alexander GC, Conti RM, Johnson M, Schumm P, Lindau ST. Use of prescription and over-the-counter medications and dietary supplements among older adults in the United States. *Journal of the American Medical Association*. 2008;**300**:2867–78.
- **57** Walker R, Hinchliffe A. Prescribing and sale of ophthalmic chloramphenicol following reclassification to over-the-counter availability. *International Journal of Pharmacy Practice*. 2010;**18**:269–74.
- **58** von Euler M, Keshani S, Baatz K, Wettermark B. Utilization of triptanes in Sweden; analyses of over the counter and prescriptions sales. *Pharmacoepidemiology and Drug Safety.* 2014;**23**:1288–93.
- **59** Andrade SE, Gurwitz JH, Fish LS. The effect of an Rx-to-OTC switch on medication prescribing patterns and utilization of physician services: the case of H2-receptor antagonists. *Medical Care*. 1999;**37**:424–30.
- **60** Sullivan PW, Nair KV, Patel BV. The effect of the Rx-to-OTC switch of loratadine and changes in prescription drug benefits on utilization and cost of therapy. *American Journal of Managed Care*. 2005;**11**:374–82.
- **61** Filion KB, Delaney JA, Brophy JM, Ernst P, Suissa S. The impact of over-the-counter simvastatin on the

- number of statin prescriptions in the United Kingdom: a view from the General Practice Research Database. *Pharmacoepidemiology and Drug Safety.* 2007;**16**:1–4.
- Gauld NJ, Kelly FS, Kurosawa N, Bryant LJ, Emmerton LM, Buetow SA. Widening consumer access to medicines through switching medicines to non-prescription: a six country comparison. *PLoS ONE*. 2014;**9**(9):e107726.
- Ernst E. Prevalence of use of complementary/alternative medicine: a systematic review. *Bulletin of the World Health Organization*. 2000;**78**:252–7.
- Ni H, Simile C, Hardy AM. Utilization of complementary and alternative medicine by United

- States adults: results from the 1999 national health interview survey. *Medical Care*. 2002;**40**:353–8.
- Klepser TB, Doucette WR, Horton MR, Buys LM, Ernst ME, Ford JK, et al. Assessment of patients' perceptions and beliefs regarding herbal therapies. *Pharmacotherapy.* 2000;**20**:83–7.
- Stange R, Amhof R, Moebus S. Complementary and alternative medicine: attitudes and patterns of use by German physicians in a national survey. *Journal of Alternative and Complementary Medicine*. 2008;**14**:1255–61.

Chapter 19

Key references/suggested reading are marked with an asterisk.*

- **1** Babar ZU, Francis S. Identifying priority medicines policy issues for New Zealand: a general inductive study. *British Medical Journal Open*. 2014;**4**(5):e004415.
- **2** Drews J. Drug discovery: a historical perspective. *Science*. 2000;**287**(5460):1960–4.
- **3** Mousnad MA, Shafie AA, Ibrahim MI. Systematic review of factors affecting pharmaceutical expenditures. *Health Policy*. 2014;**116**(2–3):137–46.
- **4** Godman B, Campbell S, Suh HS, Finlayson A, Bennie M, Gustafsson L. Ongoing measures to enhance prescribing efficiency across Europe: implications for other countries. *Journal of Health Technology Assessment*. 2013;1:27–42.
- 5 Organisation for Economic Co-operation and Development. Health at a Glance 2011. OECD Indicators. Pharmaceutical expenditure. Available from: http://www.oecd.org/els/health-systems/49105858.pdf (18 November 2015).
- **6** Cameron A, Ewen M, Ross-Degnan D, Ball D, Laing R. Medicine prices, availability, and affordability in 36 developing and middle-income countries: a secondary analysis. *Lancet*. 2009;**373**(9659):240–9.
- **7** Garattini S, Bertele V, Godman B, Haycox A, Wettermark B, Gustafsson LL. Enhancing the rational use of new medicines across European health care systems. *European Journal of Clinical Pharmacology*. 2008:**64**(12):1137–8.
- **8** Godman B, Petzold M, Bennett K, Bennie M, Bucsics A, Finlayson AE, et al. Can authorities appreciably enhance the prescribing of oral generic risperidone to conserve resources?: Findings from across Europe and their implications. *BMC Medicine*. 2014;**12**(1):98.
- **9** Godman B, Malmstrom RE, Diogene E, Jayathissa S, McTaggart S, Cars T, et al. Dabigatran a continuing

- exemplar case history demonstrating the need for comprehensive models to optimize the utilization of new drugs. *Frontiers in Pharmacology.* 2014;**5**:109.
- **10** Lubloy A. Factors affecting the uptake of new medicines: a systematic literature review. *BMC Health Services Research*. 2014;**14**:469.
- 11 Kaplan W, Wirtz V, Mantel-Teeuwisse A, Stolk P, Duthey B, Laing R. Priority Medicines for Europe and the World 2013 Update. Available from: http://www.who.int/medicines/areas/priority_medicines/MasterDocJune28_FINAL_Web.pdf?ua=1 (last accessed 18 November 2015).
- **12** Malmstrom RE, Godman BB, Diogene E, Baumgartel C, Bennie M, Bishop I, et al. Dabigatran a case history demonstrating the need for comprehensive approaches to optimize the use of new drugs. *Frontiers in Pharmacology.* **2013**;**4**:39.
- **13** Garuoliene K, Alonderis T, Marcinkevic us M. Pharmaceutical policy and the effects of the economic crisis: Lithuania. *EuroHealth*. 2011;**17**:1–4.
- **14** Godman B, Malmstrom RE, Diogene E, Gray A, Jayathissa S, Timoney A, et al. Are new models needed to optimize the utilization of new medicines to sustain healthcare systems? *Expert Review of Clinical Pharmacology*. **2015**;**8**(1):77–94.
- 15 Campbell SM, Godman B, Diogene E, Furst J, Gustafsson LL, MacBride-Stewart S, et al. Quality indicators as a tool in improving the introduction of new medicines. *Basic & Clinical Pharmacology & Toxicology*. 2015;116(2):146–57.
- 16 Godman B, Wettermark B, van Woerkom M, Fraeyman J, Alvarez-Madrazo S, Berg C, et al. Multiple policies to enhance prescribing efficiency for established medicines in Europe with a particular focus on demand-side measures: findings and future implications. *Frontiers in Pharmacology*. 2014;5:106.
- 17 Seiter A. A Practical Approach to Pharmaceutical Policy. Washington, DC, World Bank, 2010. Available from:

- https://openknowledge.worldbank.org/bitstream/handle/10986/2468/552030PUB0Phar10Box349442B01PUBLIC1.pdf?sequence=4 (last accessed 18 November 2015). *Good overview of pharmaceutical policies across countries, including practical approaches.
- **18** Traulsen JM, Almarsdottir AB. The argument for pharmaceutical policy. *Pharmacy World & Science*. 2005;**27**(1):7–12. *Gives good background to pharmaceutical policies.
- **19** Almarsdottir AB, Traulsen JM. Rational use of medicines an important issue in pharmaceutical policy. *Pharmacy World & Science*. 2005;**27**(2):76–80. **Gives good background to pharmaceutical policies*.
- **20** Wagner AK, Graves AJ, Reiss SK, Lecates R, Zhang F, Ross-Degnan D. Access to care and medicines, burden of health care expenditures, and risk protection: results from the World Health Survey. *Health Policy*. 2011;**100**(2–3):151–8.
- **21** Barber SL, Huang B, Santoso B, Laing R, Paris V, Wu C. The reform of the essential medicines system in China: a comprehensive approach to universal coverage. *Journal of Global Health*. 2013;**3**(1):010303.
- **22** Li X, Zhang W. The impacts of health insurance on health care utilization among the older people in China. *Social Science & Medicine*. 2013;**85**:59–65.
- 23 Van Minh H, Kim Phuong NT, Saksena P, James CD, Xu K. Financial burden of household out-of pocket health expenditure in Viet Nam: findings from the National Living Standard Survey 2002–2010. Social Science & Medicine. 2013;96:258–63.
- 24 European Federation of Pharmaceutical Industries and Associations. Health & Growth: Working Together for a Healthy Europe. A Vision Towards a Life Sciences Strategy for Europe. Brussels, European Federation of Pharmaceutical Industries and Associations, 2014. Available from: http://www.efpia.eu/uploads/documents/EFPIA-health&growth_MANIFESTO_V11_pbp.pdf (last accessed 18 November 2015).
- 25 EvaluatePharma. Surveying Tomorrow's BioPharma Landscape. The NASDAQ Biotech Index Up Close. Available from: http://info.evaluatepharma.com/rs/evaluatepharmaltd/images/EvaluatePharma_NBI_Up_Close_2012.pdf (last accessed 18 November 2015).
- **26** Dylst P, Vulto A, Simoens S. Analysis of European policy towards generic medicines. *Generics and Biosimilars Initiative Journal*. 2014;**3**(1):34–5.
- **27** Vogler S. The impact of pharmaceutical pricing and reimbursement policies on generics uptake: imple-

- mentation of policy options on generics in 29 European countries an overview. Generics and *Biosimilars Initiative Journal*. 2012;1(2):93–100.
- 28 Ministry of Health Malaysia. Malaysian National Medicines Policy (DUNAS). Available from: http://www.pharmacy.gov.my/v2/en/documents/malaysian-national-medicines-policy-dunas.html (last accessed 18 November 2015).
- 29 Godman B, Wettermark B, Hoffmann M, Andersson K, Haycox A, Gustafsson LL. Multifaceted national and regional drug reforms and initiatives in ambulatory care in Sweden: global relevance. *Expert Review of Pharmacoeconomics & Outcomes Research*. 2009;9(1):65–83.
- **30** Wettermark B, Godman B, Neovius M, Hedberg N, Mellgren TO, Kahan T. Initial effects of a reimbursement restriction to improve the cost-effectiveness of antihypertensive treatment. *Health Policy*. 2010;**94**(3):221–9.
- **31** Gustafsson LL, Wettermark B, Godman B, Andersen-Karlsson E, Bergman U, Hasselstrom J, et al. The 'wise list'- a comprehensive concept to select, communicate and achieve adherence to recommendations of essential drugs in ambulatory care in Stockholm. *Basic & Clinical Pharmacology & Toxicology*. 2011;**108**(4):224–33.
- **32** Almarsdottir AB, Traulsen JM. Cost-containment as part of pharmaceutical policy. *Pharmacy World & Science*. 2005;**27**(3):144–8. **Gives good background to pharmaceutical policies*.
- **33** Vogler S, Zimmermann N. How do regional sickness funds encourage more rational use of medicines, including the increase of generic uptake? A case study from Austria. *Generics and Biosimilars Initiative Journal*. 2013;**2**(2):65–75.
- **34** Vogler S, Zimmermann N, Leopold C, de Joncheere K. Pharmaceutical policies in European countries in response to the global financial crisis. *Southern Medicine Review.* 2011;**4**(2):69–79.
- **35** Rietveld AH, Haaijer-Ruskamp F. Policy options for cost containment of pharmaceuticals. In: Dukes MNG, Haaijer-Ruskamp FM, de Joncheere CP, Rietveld AH, eds. *Drugs and Money: Prices, Affordability and Cost Containment*. Amsterdam, IOS Press, 2003: 29–54. *Gives a good overview of policy options.
- **36** Ferrario A, Kanavos P. Managed entry agreements for pharmaceuticals: the European experience. Available from: http://core.ac.uk/download/

- pdf/16379320.pdf (last accessed 18 November 2015). *Good overview of managed entry strategies across Europe their strengths as well as concerns.
- Adamski J, Godman B, Ofierska-Sujkowska G, Osinska B, Herholz H, Wendykowska K, et al. Risk sharing arrangements for pharmaceuticals: potential considerations and recommendations for European payers. *BMC Health Services Research*. 2010;**10**:153.
- 38 Paris V, Belloni A. Value in Pharmaceutical Pricing. OECD Health Working Papers, No. 63. Washington, DC, OECD Publishing, 2013. Available from: http://dx.doi.org/10.1787/5k43jc9v6knx-en (last accessed 18 November 2015). *Provides a good overview of how countries assess pricing and reimbursement for new medicines, including issues of comparators and methods for economic evaluation.
- Sabuncu E, David J, Bernede-Bauduin C, Pepin S, Leroy M, Boelle PY, et al. Significant reduction of antibiotic use in the community after a nationwide campaign in France, 2002–2007. *PLoS Medicine*. 2009;**6**(6):e1000084.
- **40** Kontopantelis E, Reeves D, Valderas JM, Campbell S, Doran T. Recorded quality of primary care for patients with diabetes in England before and after the introduction of a financial incentive scheme: a longitudinal observational study. *BMJ Quality & Safety.* 2013;**22**(1):53−64.
- **41** Godman B, Bishop I, Finlayson AE, Campbell S, Kwon HY, Bennie M. Reforms and initiatives in Scotland in recent years to encourage the prescribing of generic drugs, their influence and implications for other countries. *Expert Review of Pharmacoeconomics & Outcomes Research*. 2013;**13**(4):469–82.
- Garuoliene K, Godman B, Gulbinovic J, Wettermark B, Haycox A. European countries with small populations can obtain low prices for drugs: Lithuania as a case history. *Expert Review of Pharmacoeconomics & Outcomes Research*. 2011;**11**(3):343–9.
- Abuelkhair M, Abdu S, Godman B, Fahmy S, Malmstrom RE, Gustafsson LL. Imperative to consider multiple initiatives to maximize prescribing efficiency from generic availability: case history from Abu Dhabi. *Expert Review of Pharmacoeconomics & Outcomes Research*. 2012;**12**(1):115–24.
- **44** Sandheimer C, Karlberg I. Ten years experience with models for financing of our patient prescriptions. *Health Policy and Technology*. 2013;**2**:188–95.

- Morgan SG, Thomson PA, Daw JR, Friesen MK. Canadian policy makers' views on pharmaceutical reimbursement contracts involving confidential discounts from drug manufacturers. *Health Policy*. 2013;**112**(3):248–54.
- Morgan SG, Friesen MK, Thomson PA, Daw JR. Use of product listing agreements by Canadian provincial drug benefit plans. *Healthcare Policy*. 2013;**8**(4):45–55.
- Horn H, Nink K, McGauran N, Wieseler B. Early benefit assessment of new drugs in Germany results from 2011 to 2012. *Health Policy*. 2014;**116**(2–3):147–53.
- Gerber A, Stock S, Dintsios CM. Reflections on the changing face of German pharmaceutical policy: how far is Germany from value-based pricing? *Pharmacoeconomics*. 2011;**29**(7):549–53.
- Godman B, Bucsics A, Burkhardt T, Haycox A, Seyfried H, Wieninger P. Insight into recent reforms and initiatives in Austria: implications for key stakeholders. *Expert Review of Pharmacoeconomics & Outcomes Research.* 2008;**8**(4):357–71.
- Godman B, Gustafsson LL. A new reimbursement system for innovative pharmaceuticals combining value-based and free market pricing. *Applied Health Economics and Health Policy*. 2013;**11**(1):79–82.
- **51** Ford JA, Waugh N, Sharma P, Sculpher M, Walker A. NICE guidance: a comparative study of the introduction of the single technology appraisal process and comparison with guidance from Scottish Medicines Consortium. *British Medical Journal Open*. 2012;**2**(1):e000671.
- Clement FM, Harris A, Li JJ, Yong K, Lee KM, Manns BJ. Using effectiveness and cost-effectiveness to make drug coverage decisions: a comparison of Britain, Australia, and Canada. *Journal of the American Medical Association*. 2009;**302**(13):1437–43.
- 53 Yim EY, Lim SH, Oh MJ, Park HK, Gong JR, Park SE, et al. Assessment of pharmacoeconomic evaluations submitted for reimbursement in Korea. *Value in Health*. 2012;15(1 Suppl.):S104–10.
- Wettermark B, Godman B, Jacobsson B, Haaijer-Ruskamp FM. Soft regulations in pharmaceutical policy making: an overview of current approaches and their consequences. *Applied Health Economics and Health Policy*. 2009;**7**(3):137–47.
- Godman B, Shrank W, Andersen M, Berg C, Bishop I, Burkhardt T, et al. Comparing policies to enhance

- prescribing efficiency in Europe through increasing generic utilization: changes seen and global implications. *Expert Review of Pharmacoeconomics & Outcomes Research.* 2010;**10**(6):707–22.
- 56 Voncina L, Strizrep T, Godman B, Bennie M, Bishop I, Campbell S, et al. Influence of demandside measures to enhance renin-angiotensin prescribing efficiency in Europe: implications for the future. Expert Review of Pharmacoeconomics & Outcomes Research. 2011;11(4):469–79.
- 57 Moon JC, Godman B, Petzold M, Alvarez-Madrazo S, Bennett K, Bishop I, et al. Different initiatives across Europe to enhance losartan utilization post generics: impact and implications. *Frontiers in Pharmacology*. 2014;5:219.
- 58 Sketris I, Ingram E, Lummis H. Optimal prescribing and medication use in Canada challenges and opportunities. Available from: http://healthcouncilcanada.ca/tree/2.37.1-Appendices_OptimizingPrescribingBehaviours.pdf (last accessed 18 November 2015).
- **59** Tordrup D, Angelis A, Kanavos P. Preferences on policy options for ensuring the financial sustainability of health care services in the future: results of a stakeholder survey. *Applied Health Economics and Health Policy*. 2013;**11**(6):639–52.
- **60** Godman B, Shrank W, Andersen M, Berg C, Bishop I, Burkhardt T, et al. Policies to enhance prescribing efficiency in europe: findings and future implications. *Frontiers in Pharmacology*. 2010;1:141.
- **61** Cacace M, Ettelt S, Mays N, Nolte E. Assessing quality in cross-country comparisons of health systems and policies: towards a set of generic quality criteria. *Health Policy*. 2013;**112**(1–2):156–62. **Provides good advice for undertaking CNC studies*.
- **62** Wettermark B. The intriguing future of pharmacoepidemiology. European Journal of Clinical Pharmacology. 2013;**69**(Suppl. 1):43–51. *Gives examples of potenital drug utilization studies that can be undertaken given certain datasources.
- **63** Almarsdottir AB, Traulsen JM. Studying and evaluating pharmaceutical policy becoming a part of the policy and consultative process. *Pharmacy World & Science*. 2006;**28**(1):6−12. **Gives good background to pharmaceutical policies*.
- **64** Wagner AK, Soumerai SB, Zhang F, Ross-Degnan D. Segmented regression analysis of interrupted time series studies in medication use research. *Journal of*

- Clinical Pharmacy and Therapeutics. 2002;**27**(4):299–309. *Good background methodology chapter.
- 65 Bero LA, Grilli R, Grimshaw JM, Harvey E, Oxman AD, Thomson MA. Closing the gap between research and practice: an overview of systematic reviews of interventions to promote the implementation of research findings. The Cochrane Effective Practice and Organization of Care Review Group. *British Medical Journal*. 1998;317(7156):465–8.
- **66** Grimshaw J, Campbell M, Eccles M, Steen N. Experimental and quasi-experimental designs for evaluating guideline implementation strategies. *Family Practice*. 2000;**17**(Suppl. 1):S11–16.
- 67 Australian Government Department of Health and Ageing. National Medicines Policy 2000. Available from: http://www.health.gov.au/internet/main/publishing.nsf/Content/B2FFBF72029EEA C8CA257BF0001BAF3F/\$File/NMP2000.pdf (last accessed 18 November 2015).
- **68** Australian Government Department of Health and Ageing. The National Strategy for Quality Use of Medicines Executive Summary. Available from: http://www.health.gov.au/internet/main/publishing.nsf/Content/46121C0B732612B9CA257BF0001CFED0/\$File/execsumbro.pdf (last accessed 18 November 2015).
- **69** NPS MedicineWise. About Us. Available from: http://www.nps.org.au/about-us (last accessed 18 November 2015).
- 70 Weekes LM, Brooks C. Drug and therapeutics committees in Australia: expected and actual performance. *British Journal of Clinical Pharmacology*. 1996;42(5):551–7.
- **71** Tan EL, Day RO, Brien JA. Prioritising drug and therapeutics committee (DTC) decisions: a national survey. *Pharmacy World & Science*. 2007;**29**(2):90–6.
- **72** Stafinski T, Menon D, McCabe C, Philippon DJ. To fund or not to fund: development of a decision-making framework for the coverage of new health technologies. *Pharmacoeconomics*. 2011;**29**(9):771–80.
- **73** Morgan SG, Thomson PA, Daw JR, Friesen MK. Inter-jurisdictional cooperation on pharmaceutical product listing agreements: views from Canadian provinces. *BMC Health Services Research*. 2013;**13**:34.
- **74** Khan S, Moore JE, Gomes T, Camacho X, Tran J, McAuley G, et al. The Ontario Drug Policy Research Network: bridging the gap between Research and Drug Policy. *Health Policy*. 2014;**117**(3):392–8.

- **75** Kim Y, Yang B. Relationship between catastrophic health expenditures and household incomes and expenditure patterns in South Korea. *Health Policy*. 2011;**100**(2–3):239–46.
- 76 Kwon H-Y, Yang B, Godman B. Key components of increased drug expenditure in South Korea; implications for the future. *Value in Health Regional Issues*. 2015;6:14–21
- 77 Gauld R. Ahead of its time? Reflecting on New Zealand's Pharmac following its 20th anniversary. *Pharmacoeconomics*. 2014;**32**(10):937–42.
- **78** Babar ZUD, Vitry A. Differences in Australian and New Zealand medicines funding policies. *Australian Prescriber*. 2014;**37**:150–1.
- **79** Metcalfe S, Grocott R, Rasiah D. Comment on 'Ahead of Its Time? Reflecting on New Zealand's Pharmac Following its 20th Anniversary': clarification from PHARMAC: PHARMAC takes no particular distributive approach (utilitarian or otherwise). *Pharmacoeconomics*. 2014;**32**(10):1031–3.
- **80** Wonder M, Milne R. Access to new medicines in New Zealand compared to Australia. *New Zealand Medical Journal*. 2011;**124**(1346):12–28.
- **81** Bjorkhem-Bergman L, Andersen-Karlsson E, Laing R, Diogene E, Melien O, Jirlow M, et al. Interface management of pharmacotherapy. Joint hospital and primary care drug recommendations. *European Journal of Clinical Pharmacology*. 2013;**69**(Suppl. 1):73–8.
- **82** Wettermark B, Godman B, Eriksson C, van Ganse E, Garattini S, Joppi R, et al. Einführung neuer Arzneimittel in europäische Gesundheitssysteme [Introduction of new medicines into European healthcare systems]. *GGW*. 2010;**10**(3):24–34.
- 83 Godman B, Burkhardt T, Bucsics A, Wettermark B, Wieninger P. Impact of recent reforms in Austria on utilisation and expenditure of PPIs and lipid lowering drugs; implications for the future. *Expert Review of Pharmacoeconomics & Outcomes Research*. 2009;9:475–84.

- **84** Mao W, Tang S, Chen W. Does perverse economic incentive lead to the irrational uses of medicines? *Expert Review of Pharmacoeconomics & Outcomes Research*. 2013;**13**(6):693–6.
- **85** Zeng W. A price and use comparison of generic versus originator cardiovascular medicines: a hospital study in Chongqing, China. *BMC Health Services Research*. 2013;**13**(1):390.
- **86** Dunne S, Shannon B, Hannigan A, Dunne C, Cullen W. Physician and pharmacist perceptions of generic medicines: what they think and how they differ. *Health Policy*. 2014;**116**(2–3):214–23.
- **87** Fürst J, čiznab M, Mrak J, Kos D, Campbell S, Coenen S, et al. The influence of a sustained multifaceted approach to improve antibiotic prescribing in Slovenia during the past decade; findings and implications. *Expert Review of Anti-Infective Therapy*. 2015;**13**(2):279–89.
- **88** Reynolds L, McKee M. Serve the people or close the sale? Profit-driven overuse of injections and infusions in China's market-based healthcare system. *International Journal of Health Planning and Management.* 2011;**26**(4):449–70.
- **89** Kiviniemi V, Peura P, Helin-Salmivaara A, Martikainen JE, Hartikainen J, Huupponen R, et al. Suboptimal use of statins at treatment initiation. *European Journal of Clinical Pharmacology*. 2011;**67**(9):971–3.
- **90** Shrank WH, Hoang T, Ettner SL, Glassman PA, Nair K, DeLapp D, et al. The implications of choice: prescribing generic or preferred pharmaceuticals improves medication adherence for chronic conditions. *Archives of Internal Medicine*. 2006;**166**(3):332–7.
- 91 Andersson K, Sonesson C, Petzold M, Carlsten A, Lonnroth K. What are the obstacles to generic substitution? An assessment of the behaviour of prescribers, patients and pharmacies during the first year of generic substitution in Sweden. *Pharmacoepidemiology and Drug Safety.* 2005;14(5):341–8.

Chapter 20

Key references/suggested reading are marked with an asterisk.*

- 1 Organisation for Economic Co-operation and Development. Health at a Glance 2011: OECD Indicators. Pharmaceutical expenditure. OECD Publishing. Available from: http://www.oecd.org/els/health-systems/49105858.pdf (last accessed 18 November 2015).
- 2 Malmstrom RE, Godman BB, Diogene E, Baumgartel C, Bennie M, Bishop I, et al. Dabigatran a case history demonstrating the need for comprehensive approaches to optimize the use of new drugs. Frontiers in Pharmacology. 2013;4:39. *Key reference documenting potential models by which to optimize the utilization of new medicines.
- **3** Godman B, Malmstrom RE, Diogene E, Gray A, Jayathissa S, Timoney A, et al. Are new models needed to optimize the utilization of new medicines to sustain healthcare systems? *Expert Review of Clinical Pharmacology*. 2015;**8**(1):77–94.
- **4** Garuoliene K, Alonderis T, Marcinkevic us M. Pharmaceutical policy and the effects of the economic crisis: Lithuania. *EuroHealth*. 2011;**17**:1–4.
- 5 Experts in Chronic Myeloid Leukemia: Abboud C, Berman E, Cohen A, Cortes J, DeAngelo D, Deininger M, et al. The price of drugs for chronic myeloid leukemia (CML) is a reflection of the unsustainable prices of cancer drugs: from the perspective of a large group of CML experts. *Blood*. 2013;121(22):4439–42.
- **6** Kaiser J. Personalized medicine. New cystic fibrosis drug offers hope, at a price. *Science*. 2012;**335**(6069):645.
- 7 Campbell T. Expanding use of Alexion's specialty drug Soliris. Available from: http://seekingalpha.com/article/1457331-expanding-use-of-alexions-specialty-drug-soliris-offers-upside (last accessed 18 November 2015).

- 8 European Federation of Pharmaceutical Industries and Associations. Health & Growth: Working Together for a Healthy Europe. A Vision Towards a Life Sciences Strategy for Europe. Brussels, European Federation of Pharmaceutical Industries and Associations, 2014. Available from: http://www.efpia.eu/uploads/documents/EFPIAhealth&growth_MANIFESTO_V11_pbp.pdf (last accessed 18 November 2015).
- **9** Lubloy A. Factors affecting the uptake of new medicines: a systematic literature review. *BMC Health Services Research*. 2014;**14**:469.
- **10** Light DW, Lexchin JR. Pharmaceutical research and development: what do we get for all that money? *British Medical Journal*. 2012;**345**:e4348.
- 11 Godman B, Bucsics A, Burkhardt T, Haycox A, Seyfried H, Wieninger P. Insight into recent reforms and initiatives in Austria: implications for key stakeholders. *Expert Review of Pharmacoeconomics & Outcomes Research.* 2008;8(4):357–71.
- **12** Anon. New drugs and indications in 2011. France is better focused on patients' interests after the Mediator scandal, but stagnation elsewhere. *Prescrire International*. 2012;**21**(126):106–7.
- **13** Vitry AI, Shin NH, Vitre P. Assessment of the therapeutic value of new medicines marketed in Australia. *Journal of Pharmaceutical Policy and Practice*. 2013;**6**:2.
- **14** Kantarjian HM, Fojo T, Mathisen M, Zwelling LA. Cancer drugs in the United States: Justum Pretium the just price. *Journal of Clinical Oncology*. 2013;**31**(28):3600–4.
- **15** Keegan BM. Natalizumab for multiple sclerosis: a complicated treatment. *Lancet Neurology*. 2011;**10**(8):677–8.
- **16** Kappos L, Bates D, Edan G, Eraksoy M, Garcia-Merino A, Grigoriadis N, et al. Natalizumab treatment for multiple sclerosis: updated recommendations for

- patient selection and monitoring. *Lancet Neurology*. 2011;**10**(8):745–58.
- 17 Godman B, Malmstrom RE, Diogene E, Jayathissa S, McTaggart S, Cars T, et al. Dabigatran a continuing exemplar case history demonstrating the need for comprehensive models to optimize the utilization of new drugs. *Frontiers in Pharmacology*. 2014;**5**:109.
- **18** Larock AS, Mullier F, Sennesael AL, Douxfils J, Devalet B, Chatelain C, et al. Appropriateness of prescribing dabigatran etexilate and rivaroxaban in patients with nonvalvular atrial fibrillation: a prospective study. 2014;**48**(10):1258–68.
- **19** Cohen D. Dabigatran: how the drug company withheld important analyses. *British Medical Journal*. 2014;**349**:g4670.
- 20 Phend C. Monitoring, dose adjustment for Pradaxa? Available from: http://www.medpagetoday.com/ Cardiology/Arrhythmias/46901 (last accessed 18 November 2015).
- **21** Moore TJ, Cohen MR, Mattison DR. Dabigatran, bleeding, and the regulators. *British Medical Journal*. 2014;**349**:g4517.
- **22** Eichler HG, Abadie E, Breckenridge A, Flamion B, Gustafsson LL, Leufkens H, et al. Bridging the efficacy-effectiveness gap: a regulator's perspective on addressing variability of drug response. *Nature Reviews Drug Discovery*. 2011;**10**(7):495–506.
- 23 Friedman MA, Woodcock J, Lumpkin MM, Shuren JE, Hass AE, Thompson LJ. The safety of newly approved medicines: do recent market removals mean there is a problem? *Journal of the American Medical Association*. 1999;281(18):1728–34.
- **24** Ioannides-Demos LL, Piccenna L, McNeil JJ. Pharmacotherapies for obesity: past, current, and future therapies. *Journal of Obesity*. 2011;**2011**:179674.
- 25 McNaughton R, Huet G, Shakir S. An investigation into drug products withdrawn from the EU market between 2002 and 2011 for safety reasons and the evidence used to support the decision-making. *British Medical Journal Open.* 2014;4(1):e004221.
- **26** Griffin JP, Griffin TD. The economic implications of therapeutic conservatism. *Journal of the Royal College of Physicians of London*. 1993;**27**(2):121–6.
- 27 Richards MP. Extent and Causes of International Variations in Drug Usage. A Report for the Secretary of State for Health. Available from: https:// www.gov.uk/government/uploads/system/uploads/

- attachment_data/file/216249/dh_117977.pdf (last accessed 18 November 2015).
- 28 Packer C, Simpson S, Stevens A. International diffusion of new health technologies: a ten-country analysis of six health technologies. *International Journal of Technology Assessment in Health Care*. 2006;22(4):419–28.
- **29** Mason A. New medicines in primary care: a review of influences on general practitioner prescribing. *Journal of Clinical Pharmacy and Therapeutics*. 2008;**33**(1):1–10.
- **30** Spurling GK, Mansfield PR, Montgomery BD, Lexchin J, Doust J, Othman N, et al. Information from pharmaceutical companies and the quality, quantity, and cost of physicians' prescribing: a systematic review. *PLoS Medicine*. 2010;**7**(10):e1000352.
- **31** Dunn AG, Braithwaite J, Gallego B, Day RO, Runciman W, Coiera E. Nation-scale adoption of new medicines by doctors: an application of the Bass diffusion model. *BMC Health Services Research*. 2012;**12**:248.
- **32** Garattini S, Bertele V, Godman B, Haycox A, Wettermark B, Gustafsson LL. Enhancing the rational use of new medicines across European health care systems. *European Journal of Clinical Pharmacology*. 2008;**64**(12):1137–8.
- **33** Chauhan D, Mason A. Factors affecting the uptake of new medicines in secondary care a literature review. *Journal of Clinical Pharmacy and Therapeutics*. 2008;**33**(4):339–48.
- **34** Bjorkhem-Bergman L, Andersen-Karlsson E, Laing R, Diogene E, Melien O, Jirlow M, et al. Interface management of pharmacotherapy. Joint hospital and primary care drug recommendations. *European Journal of Clinical Pharmacology*. 2013;**69**(Suppl. 1):73–8.
- 35 Vogler S, Zimmermann N, Habl C, Mazag J. The role of discounts and loss leaders in medicine procurement in Austrian hospitals a primary survey of official and actual medicine prices. *Cost Effectiveness and Resource Allocation*. 2013;11(1):15.
- **36** Spatz I, McGee N. Health policy brief: specialty pharmaceuticals. *Health Affairs*. 25 November 2013:1–4.
- **37** Litchtenberg F. Pharmaceutical innovation and longevity growth in 30 developing and high-income countries, 2000–2009. *Health Policy and Technology*. 2014;**3**:36–58.

- **38** Ferrario A, Kanavos P. Managed entry agreements for pharmaceuticals: the European experience. Available from: http://core.ac.uk/download/pdf/16379320.pdf (last accessed 18 November 2015).
- **39** Cheema PK, Gavura S, Migus M, Godman B, Yeung L, Trudeau ME. International variability in the reimbursement of cancer drugs by publically funded drug programs. *Current Oncology*. 2012;**19**(3):e165–76.
- **40** Adamski J, Godman B, Ofierska-Sujkowska G, Osinska B, Herholz H, Wendykowska K, et al. Risk sharing arrangements for pharmaceuticals: potential considerations and recommendations for European payers. *BMC Health Services Research*. 2010;**10**:153.
- **41** Klemp M, Fronsdal KB, Facey K. What principles should govern the use of managed entry agreements? *International Journal of Technology Assessment in Health Care*. 2011;**27**(1):77–83.
- **42** Jommi C. Managed market entry for drugs in Italy. *EMAUD Market Access Newsletter 2012*. June 2012.
- **43** Liner L. Recent development for CED in Sweden. EMAUD Market Access Newsletter 2012. June 2012.
- 44 PharmaFutures. PharmaFutures Global Conclusions. Pathways to Value: Pharma in a Changing World. Available from: http://apps.who.int/medicinedocs/documents/s20202en/s20202en.pdf (last accessed 18 November 2015).
- **45** Seiter A. A Practical Approach to Pharmaceutical Policy. Washington, DC, World Bank, 2010. Available from: https://openknowledge.worldbank.org/bitstream/handle/10986/2468/552030PUB0Phar-10Box349442B01PUBLIC1.pdf?sequence=4 (last accessed 18 November 2015). *Provides a good practical approach to pharmaceutical policy.
- **46** Van Minh H, Kim Phuong NT, Saksena P, James CD, Xu K. Financial burden of household out-of pocket health expenditure in Viet Nam: findings from the National Living Standard Survey 2002–2010. *Social Science & Medicine*. 2013;**96**:258–63.
- **47** Barber SL, Huang B, Santoso B, Laing R, Paris V, Wu C. The reform of the essential medicines system in China: a comprehensive approach to universal coverage. *Journal of Global Health*. 2013;**3**(1):010303.
- **48** Meng Q, Xu L, Zhang Y, Qian J, Cai M, Xin Y, et al. Trends in access to health services and financial protection in China between 2003 and 2011: a cross-sectional study. *Lancet*. 2012;**379**(9818):805–14.

- **49** Li X, Zhang W. The impacts of health insurance on health care utilization among the older people in China. *Social Science & Medicine*. 2013;**85**:59−65.
- 50 Putrik P, Ramiro S, Kvien TK, Sokka T, Pavlova M, Uhlig T, et al. Inequities in access to biologic and synthetic DMARDs across 46 European countries. Annals of the Rheumatic Diseases. 2014;73(1):198–206. *Documents differences in the uilization of anti-TNF apha medicines across Europe based on such issues as prescribing restrictions and patient copayments.
- **51** Godman B, Paterson K, Malmstrom RE, Selke G, Fagot JP, Mrak J. Improving the managed entry of new medicines: sharing experiences across Europe. *Expert Review of Pharmacoeconomics & Outcomes Research*. 2012;**12**(4):439–41.
- **52** Wettermark B. The intriguing future of pharmacoepidemiology. *European Journal of Clinical Pharmacology*. 2013;**69**(Suppl. 1):43–51.
- **53** Wettermark B, Godman B, Eriksson C, van Ganse E, Garattini S, Joppi R, et al. Einführung neuer Arzneimittel in europäische Gesundheitssysteme [Introduction of new medicines into European healthcare systems]. *GGW*. 2010;**10**(3):24–34.
- **54** Wild C, Langer T. Emerging health technologies: informing and supporting health policy early. *Health Policy*. 2008;**87**(2):160–71.
- 55 Wild C, Simpson S, Douw K, Geiger-Gritsch S, Mathis S, Langer T. Information service on new and emerging health technologies: identification and prioritization processes for a European union-wide newsletter. *International Journal of Technology Assessment in Health Care*. 2009;25(Suppl. 2):48–55.
- **56** Packer C, Fung M, Stevens A. Analyzing 10 years of early awareness and alert activity in the United kingdom. *International Journal of Technology Assessment in Health Care*. 2012;**28**(3):308–14.
- 57 Joppi R, Dematte L, Menti AM, Pase D, Poggiani C, Mezzalira L. The Italian Horizon Scanning Project. European Journal of Clinical Pharmacology. 2009;65(8):775–81. *Gives a good backround to the development of the Italian HSP and its activities.
- 58 Wettermark B, Persson ME, Wilking N, Kalin M, Korkmaz S, Hjemdahl P, et al. Forecasting drug utilization and expenditure in a metropolitan health region. *BMC Health Services Research*. 2010;10:128. *Provides a good background to the development of forecasting activities within the Stockholm region of Sweden.

- 59 Nachtnebel A, Geiger-Gritsch S, Hintringer K, Wild C. Scanning the horizon: development and implementation of an early awareness system for anticancer drugs in Austria. *Health Policy*. 2012;104(1):1–11.
- 60 Gutiérrez-Ibarluzea I, Simpson S, Joppi R, Kearney B, Packer C, Klemp M, et al. A Toolkit for the Identification and Assessment of New and Emerging Health Technologies. Birmingham, EuroScan, 2009.
- 61 Martino OI, Ward DJ, Packer C, Simpson S, Stevens A. Innovation and the burden of disease: retrospective observational study of new and emerging health technologies reported by the EuroScan Network from 2000 to 2009. *Value in Health*. 2012;15(2):376–80.
- **62** Develop, Innivate, Advance (DIA) website: www .diahome.org.
- **63** Medscape website: www.medscape.com.
- **64** Packer C. The National Horizon Scanning Centre (NHSC): early warning for new and emerging health technologies in England. *Evidence-Based Healthcare & Public Health.* 2005;**9**:410−13.
- **65** Campbell SM, Godman B, Diogene E, Furst J, Gustafsson LL, MacBride-Stewart S, et al. Quality indicators as a tool in improving the introduction of new medicines. *Basic & Clinical Pharmacology & Toxicology*. 2015;**116**(2):146–57.
- 66 Hoffman JM, Shah ND, Vermeulen LC, Doloresco F, Grim P, Hunkler RJ, et al. Projecting future drug expenditures 2008. American Journal of Health System Pharmacy. 2008;65(3):234–53.
- **67** Godman B, Wettermark B, Hoffmann M, Andersson K, Haycox A, Gustafsson LL. Multifaceted national and regional drug reforms and initiatives in ambulatory care in Sweden: global relevance. *Expert Review of Pharmacoeconomics & Outcomes Research*. 2009;**9**(1):65–83.
- **68** Rogers EM. Lessons for guidelines from the diffusion of innovations. *Joint Commission Journal on Quality Improvement*. 1995;**21**(7):324–8.
- **69** Joppi R, Pase D, Poggiani C. Italian Horizon Scanning Project. *Giornale Italiano di Health Technology Assessment*. 2013;**6**(1):11–21.
- 70 Joppi R, Cinconze E, Mezzalira L, Pase D, Poggiani C, Rossi E, et al. Hospitalized patients with atrial fibrillation compared to those included in recent trials on novel oral anticoagulants: a population-based study. European Journal of Internal Medicine. 2013;24(4):318–23. *Illustrates potential differ-

- ences that can exist between patients enrolled into phase III studies and those treated in clinical practice.
- 71 Reilly PA, Lehr T, Haertter S, Connolly SJ, Yusuf S, Eikelboom JW, et al. The effect of dabigatran plasma concentrations and patient characteristics on the frequency of ischemic stroke and major bleeding in atrial fibrillation patients: the RE-LY Trial (Randomized Evaluation of Long-Term Anticoagulation Therapy). *Journal of the American College of Cardiology*. 2014;63(4):321–8.
- **72** Godman B, Campbell S, Suh HS, Finlayson A, Bennie M, Gustafsson L. Ongoing measures to enhance prescribing efficiency across Europe: implications for other countries. *Journal of Health Technology Assessment*. 2013;**1**:27–42.
- 73 Paris V, Belloni A. Value in Pharmaceutical Pricing. OECD Health Working Papers, No. 63. Washington, DC, OECD Publishing, 2013. Available from: http://dx.doi.org/10.1787/5k43jc9v6knx-en (last accessed 18 November 2015). *Provides a comprehensive summary of the different approaches to the pricing and reimbursement of pharmaceuticals across countries, including comparators and outcome measures.
- 74 International Society for Pharmacoeconomics and Outcomes Research. Report of the ISPOR Task Force on Good Research Practices – Budget Impact Analysis. Available from: http://www.ispor.org/workpaper/BudgetImpactAnalysis/BIA_TF0906.asp (last accessed 18 November 2015).
- **75** van de Vooren K, Duranti S, Curto A, Garattini L. A critical systematic review of budget impact analyses on drugs in the EU countries. *Applied Health Economics and Health Policy*. 2014;**12**(1):33–40.
- 76 Morel T, Arickx F, Befrits G, Siviero P, van der Meijden C, Xoxi E, et al. Reconciling uncertainty of costs and outcomes with the need for access to orphan medicinal products: a comparative study of managed entry agreements across seven European countries. *Orphanet Journal of Rare Diseases*. 2013;8:198.
- 77 European Medicines Agency. Guideline on Safety and Efficacy Follow-Up Risk Management of Advanced Therapy Medicinal Products 2008. Available from: http://www.ema.europa.eu/docs/en_GB/document_library/Regulatory_and_procedural_guideline/2009/10/WC500006326.pdf (last accessed 18 November 2015).
- **78** European Medicines Agency. CHMP Recommendations for the Pharmacovigilance Plan as Part of

- the Risk Management Plan to be Submitted with the Marketing Authorisation Application for a Pandemic Influenza Vaccine. Available from: http://www.ema.europa.eu/docs/en_GB/document_library/Report/2010/01/WC500051739.pdf (last accessed 18 November 2015).
- **79** Wettermark B, Godman B, Jacobsson B, Haaijer-Ruskamp FM. Soft regulations in pharmaceutical policy making: an overview of current approaches and their consequences. *Applied Health Economics and Health Policy*. 2009;**7**(3):137–47.
- **80** Ratner J, Mullins D, Buesching DP, Cantrell RA. Pragmatic clinical trials: US payers' views on their value. *American Journal of Managed Care*. 2013;**19**(5):e158–65.
- **81** VanLare JM, Wong HH, Gibbs J, Timp R, Whang S, Worrall C, et al. Comparative effectiveness research in practice: the Drug Effectiveness Review Project experience. *Journal of Comparative Effectiveness Research*. 2013;**2**(6):541–50.
- **82** Berkowitz SA, Pahira JJ. Accountable care organization readiness and academic medical centers. *Academic Medicine*. 2014;**89**(9):1210–15.
- **83** Amara S, Adamson RT, Lew I, Slonim A. Accountable care organizations: impact on pharmacy. *Hospital Pharmacy*. 2014;**49**(3):253–9.
- **84** Edwards ST, Bitton A, Hong J, Landon BE. Patient-centered medical home initiatives expanded in 2009–13: providers, patients, and payment incentives increased. *Health Affairs*. 2014;**33**(10):1823–31.
- **85** Godman B, Persson M, Miranda J, Skiold P, Wettermark B, Barbui C, et al. Changes in the utilization of venlafaxine after the introduction of generics in Sweden. *Applied Health Economics and Health Policy*. 2013;**11**(4):383–93.
- **86** Leopold C, Vogler S, Mantel-Teeuwisse AK, de Joncheere K, Leufkens HG, Laing R. Differences in external price referencing in Europe: a descriptive overview. *Health Policy*. 2012;**104**(1):50–60.
- **87** Troncoso A, Diogene E. Dabigatran and rivaroxaban prescription for atrial fibrillation in Catalonia, Spain: the need to manage the introduction of new drugs. *European Journal of Clinical Pharmacology*. 2014;**70**(2):249–50.
- **88** Huisman MV, Lip GY, Diener HC, Dubner SJ, Halperin JL, Ma CS, et al. Design and rationale of Global

- Registry on Long-Term Oral Antithrombotic Treatment in Patients with Atrial Fibrillation: a global registry program on long-term oral antithrombotic treatment in patients with atrial fibrillation. *American Heart Journal*. 2014;**167**(3):329–34.
- **89** Piccinni C, Raschi E, Poluzzi E, Puccini A, Cars T, Wettermark B, et al. Trends in antiarrhythmic drug use after marketing authorization of dronedarone: comparison between Emilia Romagna (Italy) and Sweden. *European Journal of Clinical Pharmacology*. 2013;**69**(3):715–20.
- **90** van Vollenhoven RF, Askling J. Rheumatoid arthritis registries in Sweden. *Clinical and Experimental Rheumatology.* 2005;**23**(5 Suppl. 39):S195–200.
- **91** Raaschou P, Simard JF, Holmqvist M, Askling J. Rheumatoid arthritis, anti-tumour necrosis factor therapy, and risk of malignant melanoma: nationwide population based prospective cohort study from Sweden. *British Medical Journal*. 2013;**346**:f1939.
- **92** Forslund T, Raaschou P, Hjemdahl P, Krakau I, Wettermark B. Usage, risk, and benefit of weightloss drugs in primary care. *Journal of Obesity*. 2011;**2011**:459263. *Study demonstrating the value of patient follow-up to provide future guidance.
- 93 Gustafsson LL, Wettermark B, Godman B, Andersen-Karlsson E, Bergman U, Hasselstrom J, et al. The 'wise list' a comprehensive concept to select, communicate and achieve adherence to recommendations of essential drugs in ambulatory care in Stockholm. *Basic & Clinical Pharmacology & Toxicology*. 2011;108(4):224–33.
- **94** Martikainen JE, Saastamoinen LK, Korhonen MJ, Enlund H, Helin-Salmivaara A. Impact of restricted reimbursement on the use of statins in Finland: a register-based study. *Medical Care*. 2010;**48**(9): 761–6.
- **95** Van Hoof TJ, Miller NE, Meehan TP. Do published studies of educational outreach provide documentation of potentially important characteristics? *American Journal of Medical Quality*. 2013;**28**(6):480–4.
- **96** O'Brien MA, Rogers S, Jamtvedt G, Oxman AD, Odgaard-Jensen J, Kristoffersen DT, et al. Educational outreach visits: effects on professional practice and health care outcomes. *Cochrane Database of Systematic Reviews*. 2007(4):Cd000409.

Chapter 21

Key references/suggested reading are marked with an asterisk.*

- 1 Organisation for Economic Co-operation and Development. Health at a Glance 2011: OECD Indicators. Pharmaceutical expenditure. OECD Publishing. Available from: http://www.oecd.org/els/health-systems/49105858.pdf (last accessed 18 November 2015).
- **2** Garattini S, Bertele V, Godman B, Haycox A, Wettermark B, Gustafsson LL. Enhancing the rational use of new medicines across European health care systems. *European Journal of Clinical Pharmacology*. 2008;**64**(12):1137–8.
- **3** Luo J, Oliveira MA, Ramos MB, Maia A, Osorio-de-Castro CGS. Antiretroviral drug expenditure, pricing and judicial demand: an analysis of federal procurement data in Brazil from 2004–2011. *BMC Public Health*. 2014:**14**:367.
- 4 Caires de Souza AL, de Assis Acurcio F, Guerra Junior AA, Rezende Macedo do Nascimento RC, Godman B, Diniz LM. Insulin glargine in a Brazilian state: should the government disinvest? An assessment based on a systematic review. *Applied Health Economics and Health Policy*. 2014;12(1):19–32.
- **5** Godman B, Wettermark B, van Woerkom M, Fraeyman J, Alvarez-Madrazo S, Berg C, et al. Multiple policies to enhance prescribing efficiency for established medicines in Europe with a particular focus on demand-side measures: findings and future implications. *Frontiers in Pharmacology*. 2014;**5**:106.
- **6** Kaplan W, Wirtz V, Mantel-Teeuwisse A, Stolk P, Duthey B, Laing R. Priority Medicines for Europe and the World 2013 Update. Available from: http://www.who.int/medicines/areas/priority_medicines/MasterDocJune28_FINAL_Web.pdf?ua=1 (last accessed 18 November 2015). *Good report highlighting priority disease areas in Europe.

- **7** Gorokhovich LE, Chalkidou K, Shankar R. Improving access to innovative medicines in emerging markets: evidence and diplomacy as alternatives to the unsustainable status quo. *Journal of Health Diplomacy*. 2013;**1**(1):1–19.
- **8** Godman B, Malmstrom RE, Diogene E, Gray A, Jayathissa S, Timoney A, et al. Are new models needed to optimize the utilization of new medicines to sustain healthcare systems? *Expert Review of Clinical Pharmacology*. 2015;**8**(1):77–94.
- **9** Wagner AK, Graves AJ, Reiss SK, Lecates R, Zhang F, Ross-Degnan D. Access to care and medicines, burden of health care expenditures, and risk protection: results from the World Health Survey. *Health Policy*. 2011;**100**(2–3):151–8.
- **10** Van Minh H, Kim Phuong NT, Saksena P, James CD, Xu K. Financial burden of household out-of pocket health expenditure in Viet Nam: findings from the National Living Standard Survey 2002–2010. *Social Science & Medicine*. 2013;**96**:258–63.
- 11 Nguyen KT, Khuat OT, Ma S, Pham DC, Khuat GT, Ruger JP. Effect of health expenses on household capabilities and resource allocation in a rural commune in Vietnam. *PLoS ONE*. 2012;7(10):e47423.
- 12 Seiter A. A Practical Approach to Pharmaceutical Policy. Washington, DC, World Bank, 2010. Available from: https://openknowledge.worldbank.org/bitstream/handle/10986/2468/552030PUB0Phar-10Box349442B01PUBLIC1.pdf?sequence=4 (last accessed 18 November 2015).
- **13** Barber SL, Huang B, Santoso B, Laing R, Paris V, Wu C. The reform of the essential medicines system in China: a comprehensive approach to universal coverage. *Journal of Global Health*. 2013;**3**(1):010303.
- 14 World Health Organisation. Drug and Therapeutics Committees – A Practical Guide. Available from: http://apps.who.int/medicinedocs/pdf/s4882e/ s4882e.pdf (last accessed 18 November 2015).

15 Vogler S, Zimmermann N, Leopold C, de Joncheere K. Pharmaceutical policies in European countries in response to the global financial crisis. Southern Medi-

cine Review. 2011;4(2):69-79.

- 16 Leopold C, Mantel-Teeuwisse AK, Seyfang L, Vogler S, de Joncheere K, Laing RO, et al. Impact of external price referencing on medicine prices a price comparison among 14 European countries. *Southern Medicine Review.* 2012;5(2):34–41.
- 17 Leopold C, Vogler S, Mantel-Teeuwisse AK, de Joncheere K, Leufkens HG, Laing R. Differences in external price referencing in Europe: a descriptive overview. *Health Policy*. 2012;104(1):50–60.
- **18** Simoens S. A review of generic medicine pricing in Europe. *Generics and Biosimilars Initiative Journal*. 2012;**1**(1):8–12.
- **19** Godman B, Shrank W, Andersen M, Berg C, Bishop I, Burkhardt T, et al. Policies to enhance prescribing efficiency in europe: findings and future implications. *Frontiers in Pharmacology*. 2010;**1**:141.
- **20** Vogler S. The impact of pharmaceutical pricing and reimbursement policies on generics uptake: implementation of policy options on generics in 29 European countries an overview. Generics and *Biosimilars Initiative Journal (GaBI Journal)*. 2012;**1**(2):93–100.
- **21** Dylst P, Vulto A, Simoens S. Tendering for outpatient prescription pharmaceuticals: what can be learned from current practices in Europe? *Health Policy*. 2011;**101**(2):146–52.
- **22** Vogler S, Zimmermann N, Habl C, Piessnegger J, Bucsics A. Discounts and rebates granted to public payers for medicines in European countries. *Southern Medicine Review.* 2012;**5**(1):38–46.
- 23 Woerkom M, Piepenbrink H, Godman B, Metz J, Campbell S, Bennie M, et al. Ongoing measures to enhance the efficiency of prescribing of proton pump inhibitors and statins in The Netherlands: influence and future implications. *Journal of Comparative Effectiveness Research*. 2012;1(6):527–38.
- **24** Bennie M, Godman B, Bishop I, Campbell S. Multiple initiatives continue to enhance the prescribing efficiency for the proton pump inhibitors and statins in Scotland. *Expert Review of Pharmacoeconomics & Outcomes Research*. 2012;**12**(1):125–30.
- **25** Godman B, Wettermark B, Hoffmann M, Andersson K, Haycox A, Gustafsson LL. Multifaceted national and regional drug reforms and initiatives in ambu-

- latory care in Sweden: global relevance. *Expert Review of Pharmacoeconomics & Outcomes Research*. 2009;**9**(1):65–83.
- **26** Wettermark B, Godman B, Jacobsson B, Haaijer-Ruskamp FM. Soft regulations in pharmaceutical policy making: an overview of current approaches and their consequences. *Applied Health Economics and Health Policy*. 2009;**7**(3):137–47. *Soft regulations paper giving the background to the 4Es.
- 27 Godman B, Shrank W, Andersen M, Berg C, Bishop I, Burkhardt T, et al. Comparing policies to enhance prescribing efficiency in Europe through increasing generic utilization: changes seen and global implications. Expert Review of Pharmacoeconomics & Outcomes Research. 2010;10(6):707−22.
- **28** Voncina L, Strizrep T, Godman B, Bennie M, Bishop I, Campbell S, et al. Influence of demandside measures to enhance renin-angiotensin prescribing efficiency in Europe: implications for the future. *Expert Review of Pharmacoeconomics & Outcomes Research*. 2011;**11**(4):469–79.
- **29** Malmstrom RE, Godman BB, Diogene E, Baumgartel C, Bennie M, Bishop I, et al. Dabigatran a case history demonstrating the need for comprehensive approaches to optimize the use of new drugs. *Frontiers in Pharmacology.* **2013**;**4**:39.
- 30 Moon JC, Godman B, Petzold M, Alvarez-Madrazo S, Bennett K, Bishop I, et al. Different initiatives across Europe to enhance losartan utilization post generics: impact and implications. Frontiers in Pharmacology. 2014;5:219.
- 31 Godman B, Petzold M, Bennett K, Bennie M, Bucsics A, Finlayson AE, et al. Can authorities appreciably enhance the prescribing of oral generic risperidone to conserve resources?: Findings from across Europe and their implications. BMC Medicine. 2014;12(1):98. *CNC study showing that it is difficult for health authorities to instigate demand-side measures in order to enhance the preferential prescribing of generic atypical antipsychotics.
- **32** Garuoliene K, Alonderis T, Marcinkevic us M. Pharmaceutical policy and the effects of the economic crisis: Lithuania. *EuroHealth*. 2011;**17**:1–4.
- 33 Martin A, Godman B, Miranda J, Tilstone J, Saleem N, Olsson E, et al. Measures to improve angiotensin receptor blocker prescribing efficiency in the UK: findings and implications. *Journal of Comparative Effectiveness Research*. 2014;**3**(1):41–51.

- 34 Bjorkhem-Bergman L, Andersen-Karlsson E, Laing R, Diogene E, Melien O, Jirlow M, et al. Interface management of pharmacotherapy. Joint hospital and primary care drug recommendations. *European Journal of Clinical Pharmacology*. 2013;69(Suppl. 1):73–8.
- 35 Lima-Dellamora Eda C, Caetano R, Gustafsson LL, Godman BB, Patterson K, Osorio-de-Castro CGS. An analytical framework for assessing drug and therapeutics committee structure and work processes in tertiary brazilian hospitals. *Basic & Clinical Pharmacology & Toxicology*. 2014;**115**(3):268–76.
- **36** Hoffmann M. The right drug, but from whose perspective? A framework for analysing the structure and activities of drug and therapeutics committees. *European Journal of Clinical Pharmacology*. 2013;**69**(Suppl. 1):79–87.
- 37 Wettermark B. The intriguing future of pharmacoepidemiology. European Journal of Clinical Pharmacology. 2013;69(Suppl. 1):43–51. *Good review of potential drug utilization approaches, according to the availability of different datasets.
- **38** Grimshaw J, Campbell M, Eccles M, Steen N. Experimental and quasi-experimental designs for evaluating guideline implementation strategies. *Family Practice*. 2000;**17**(Suppl. 1):S11–16.
- 39 Wagner AK, Soumerai SB, Zhang F, Ross-Degnan D. Segmented regression analysis of interrupted time series studies in medication use research. *Journal of Clinical Pharmacy and Therapeutics*. 2002;27(4):299–309.
- **40** Zeng W, Zhen J, Feng M, Campbell SM, Finlayson AE, Godman B. Analysis of the influence of recent reforms in China: cardiovascular and cerebrovascular medicines as a case history to provide future direction. *Journal of Comparative Effectiveness Research*. 2014;**3**(4):371–86.
- **41** Cacace M, Ettelt S, Mays N, Nolte E. Assessing quality in cross-country comparisons of health systems and policies: towards a set of generic quality criteria. *Health Policy.* 2013;**112**(1–2):156–62. *Summary of necessary considerations for conducting robust CNC studies.
- **42** Markovic-Pekovic V, Skrbic R, Godman B, Gustafsson LL. Ongoing initiatives in the Republic of Srpska to enhance prescribing efficiency: influence and future directions. *Expert Review of Pharmacoeconomics & Outcomes Research*. 2012;**12**(5):661–71.
- **43** Kalaba M, Godman B, Vuksanovic A, Bennie M, Malmstrom RE. Possible ways to enhance renin-an-

- giotensin prescribing efficiency: Republic of Serbia as a case history? *Journal of Comparative Effectiveness Research*. 2012;**1**(6):539–49.
- **44** Sabate M, Pacheco JF, Ballarin E, Ferrer P, Petri H, Hasford J, et al. A compilation of research working groups on drug utilisation across Europe. *BMC Research Notes*. 2014;**7**:143. *Compilation of drug utilization research group across Europe.
- **45** Kwon HY, Hong JM, Godman B, Yang BM. Price cuts and drug spending in South Korea: the case of antihyperlipidemic agents. *Health Policy*. 2013;**112**(3):217–26.
- **46** Kesselheim AS, Outterson K. Fighting antibiotic resistance: marrying new financial incentives to meeting public health goals. *Health Affairs (Project Hope)*. 2010;**29**(9):1689–96.
- **47** Sabuncu E, David J, Bernede-Bauduin C, Pepin S, Leroy M, Boelle PY, et al. Significant reduction of antibiotic use in the community after a nationwide campaign in France, 2002–2007. *PLoS Medicine*. 2009;**6**(6):e1000084.
- **48** Goossens H, Ferech M, Vander Stichele R, Elseviers M. Outpatient antibiotic use in Europe and association with resistance: a cross-national database study. *Lancet*. 2005;**365**(9459):579–87.
- **49** Costelloe C, Metcalfe C, Lovering A, Mant D, Hay AD. Effect of antibiotic prescribing in primary care on antimicrobial resistance in individual patients: systematic review and meta-analysis. *British Medical Journal (Clinical Research Edition)*. 2010;**340**:c2096.
- **50** Barnett ML, Linder JA. Antibiotic prescribing for adults with acute bronchitis in the United States, 1996–2010. *Journal of the American Medical Association*. 2014;**311**(19):2020–2.
- **51** Velickovic-Radovanovic R, Stefanovic N, Damnjanovic I, Kocic B, Antic S, Dinic M, et al. Monitoring of antibiotic consumption and development of resistance by enterobacteria in a tertiary care hospital. Journal of clinical pharmacy and therapeutics. 2015;40(4):426–30.
- **52** Godman B, Houng V, Binh H, Thai C, Gustafsson LL. Role of DTCs in Vietnam: current situation and implications for the future. *Basic & Clinical Pharmacology & Toxicology*. 2014;**115**(Suppl. 1):86.
- 53 Godman B, Huong V, Binh N, Gustafsson LL. Current activities of DTCs in Vietnam in drug selection and development of hospital formularies. *Basic & Clinical Pharmacology & Toxicology*. 2014;115 (Suppl. 1):65.

- 54 Hassali MA, Alrasheedy AA, McLachlan A, Nguyen TA, Al-Tamimi SK, Ibrahim MI, et al. The experiences of implementing generic medicine policy in eight countries: a review and recommendations for a successful promotion of generic medicine use. Saudi Pharmaceutical Journal. 2014;22(6):491–503.
- **55** Hassali MA, Wong ZY, Alrasheedy AA, Saleem F, Mohamad Yahaya AH, Aljadhey H. Perspectives of physicians practicing in low and middle income countries towards generic medicines: a narrative review. *Health Policy*. 2014;**117**(3):297–310.
- 56 Kesselheim AS, Misono AS, Lee JL, Stedman MR, Brookhart MA, Choudhry NK, et al. Clinical equivalence of generic and brand-name drugs used in cardiovascular disease: a systematic review and meta-analysis. *Journal of the American Medical Associ*ation. 2008;300(21):2514–26.
- 57 Kesselheim AS, Stedman MR, Bubrick EJ, Gagne JJ, Misono AS, Lee JL, et al. Seizure outcomes following the use of generic versus brand-name antiepileptic drugs: a systematic review and meta-analysis. *Drugs*. 2010;70(5):605–21.
- 58 Corrao G, Soranna D, Merlino L, Mancia G. Similarity between generic and brand-name antihypertensive drugs for primary prevention of cardiovascular disease: evidence from a large population-based study. *Euro*pean Journal of Clinical Investigation. 2014;44(10):933–9.
- **59** Paton C. Generic clozapine: outcomes after switching formulations. The British journal of psychiatry: the journal of mental science. 2006;189:184–5.
- **60** World Health Organization. WHO Guideline on Country Pharmaceutical Pricing Policies. Available from: http://www.who.int/medicines/publications/pharm_guide_country_price_policy/en/(lastaccessed18 November 2015).
- 61 Carone G, Schwierz C, Xavier A. Cost-containment policies in public pharmaceutical spending in the EU. Economic Papers 461. Available from: http://ec.europa.eu/economy_finance/publications/economic_paper/2012/pdf/ecp_461_en.pdf (last accessed 18 November 2015).
- **62** Heinze G, Hronsky M, Reichardt B, Baumgartel C, Mullner M, Bucsics A, et al. Potential Savings in Prescription Drug Costs for Hypertension, Hyperlipidemia, and Diabetes Mellitus by Equivalent Drug Substitution in Austria: A Nationwide Cohort Study. Applied Health Economics and Health Policy. 2015; 13(2):193–205.

- **63** Shrank WH, Hoang T, Ettner SL, Glassman PA, Nair K, DeLapp D, et al. The implications of choice: prescribing generic or preferred pharmaceuticals improves medication adherence for chronic conditions. *Archives of Internal Medicine*. 2006;**166**(3):332–7.
- **64** Barbui C, Conti V. Adherence to generic v. brand antidepressant treatment and the key role of health system factors. *Epidemiology and Psychiatric Sciences*. 2015:**24**(1):23–6.
- **65** Kaplan WA, Ritz LS, Vitello M, Wirtz VJ. Policies to promote use of generic medicines in low and middle income countries: a review of published literature, 2000–2010. *Health Policy*. 2012;**106**(3):211–24.
- 66 Sermet C, Andrieu V, Godman B, Van Ganse E, Haycox A, Reynier JP. Ongoing pharmaceutical reforms in France: implications for key stakeholder groups. *Applied Health Economics and Health Policy*. 2010;8(1):7–24.
- **67** Andersson K, Sonesson C, Petzold M, Carlsten A, Lonnroth K. What are the obstacles to generic substitution? An assessment of the behaviour of prescribers, patients and pharmacies during the first year of generic substitution in Sweden. *Pharmacoepidemiology and Drug Safety*. 2005;**14**(5):341–8.
- 68 Godman B, Bishop I, Finlayson AE, Campbell S, Kwon HY, Bennie M. Reforms and initiatives in Scotland in recent years to encourage the prescribing of generic drugs, their influence and implications for other countries. Expert Review of Pharmacoeconomics & Outcomes Research. 2013;13(4):469–82.
- **69** Duerden MG, Hughes DA. Generic and therapeutic substitutions in the UK: are they a good thing? *British Journal of Clinical Pharmacology*. 2010;**70**(3):335–41.
- 70 Andersson KA, Petzold MG, Allebeck P, Carlsten A. Influence of mandatory generic substitution on pharmaceutical sales patterns: a national study over five years. BMC Health Services Research. 2008;8:50. *Good analysis of the impact of compulsory generic substitution in Sweden.
- **71** Weng TC, Yang YH, Lin SJ, Tai SH. A systematic review and meta-analysis on the therapeutic equivalence of statins. *Journal of Clinical Pharmacy and Therapeutics*. 2010;**35**(2):139–51.
- **72** Martikainen JE, Saastamoinen LK, Korhonen MJ, Enlund H, Helin-Salmivaara A. Impact of restricted reimbursement on the use of statins in Finland: a register-based study. *Medical Care*. 2010;**48**(9):761–6.

- 73 Usher-Smith J, Ramsbottom T, Pearmain H, Kirby M. Evaluation of the clinical outcomes of switching patients from atorvastatin to simvastatin and losartan to candesartan in a primary care setting: 2 years on. *International Journal of Clinical Practice*. 2008;62(3):480–4.
- **74** Godman B, Schwabe U, Selke G, Wettermark B. Update of recent reforms in Germany to enhance the quality and efficiency of prescribing of proton pump inhibitors and lipid-lowering drugs. *Pharmacoeconomics*. 2009;**27**(5):435–8.
- **75** Norman C, Zarrinkoub R, Hasselstrom J, Godman B, Granath F, Wettermark B. Potential savings without compromising the quality of care. *International Journal of Clinical Practice*. 2009;**63**(9):1320–6.
- 76 Sakshaug S, Furu K, Karlstad O, Ronning M, Skurtveit S. Switching statins in Norway after new reimbursement policy: a nationwide prescription study. *British Journal of Clinical Pharmacology*. 2007;64(4):476–81.
- 77 Hesse U, Godman B, Petzold M, Martin A, Malmstrom RE. Impact of delisting ARBs, apart from losartan, on ARB utilisation patterns in Denmark: implications for other countries. *Applied Health Economics and Health Policy*. 2013;11(6):677–85.
- **78** Godman B, Wettermark B, Miranda J, Bennie M, Martin A, Malmstrom RE. Influence of multiple initiatives in Sweden to enhance ARB prescribing efficiency following generic losartan; findings and implications for other countries. *International Journal of Clinical Practice*. **2013**;**67**(9):853–62.
- **79** Bennie M, Bishop I, Godman B, Campbell S, Miranda J, Finlayson AE, et al. Are prescribing initiatives readily transferable across classes: the case of generic losartan in Scotland? *Quality in Primary Care*. 2013;**21**(1):7–15.
- **80** Parks J, Radke A, Parker G, Foti ME, Eilers R, Diamond M, et al. Principles of antipsychotic prescribing for policy makers, circa 2008. Translating knowledge to promote individualized treatment. *Schizophrenia Bulletin*. 2009;**35**(5):931–6.
- **81** Wettermark B, Godman B, Neovius M, Hedberg N, Mellgren TO, Kahan T. Initial effects of a reimbursement restriction to improve the cost-effectiveness of antihypertensive treatment. *Health Policy*. 2010;**94**(3):221–9.
- **82** Gustafsson LL, Wettermark B, Godman B, Andersen-Karlsson E, Bergman U, Hasselstrom J, et al. The 'wise list' a comprehensive concept to select,

- communicate and achieve adherence to recommendations of essential drugs in ambulatory care in Stockholm. *Basic & Clinical Pharmacology & Toxicology*. 2011;**108**(4):224–33.
- **83** Niquille A, Ruggli M, Buchmann M, Jordan D, Bugnon O. The nine-year sustained cost-containment impact of swiss pilot physicians-pharmacists quality circles. *Annals of Pharmacotherapy*. 2010;**44**(4):650–7.
- **84** Wensing M, Broge B, Riens B, Kaufmann-Kolle P, Akkermans R, Grol R, et al. Quality circles to improve prescribing of primary care physicians: three comparative studies. *Pharmacoepidemiology and Drug Safety*. 2009;**18**(9):763–9.
- 85 Doran T, Kontopantelis E, Valderas JM, Campbell S, Roland M, Salisbury C, et al. Effect of financial incentives on incentivised and non-incentivised clinical activities: longitudinal analysis of data from the UK Quality and Outcomes Framework. *British Medical Journal*. 2011;342:d3590.
- **86** Wettermark B, Pehrsson A, Juhasz-Haverinen M, Veg A, Edlert M, Tornwall-Bergendahl G, et al. Financial incentives linked to self-assessment of prescribing patterns: a new approach for quality improvement of drug prescribing in primary care. *Quality in Primary Care*. 2009;**17**(3):179–89.
- **87** Godman B, Abuelkhair M, Vitry A, Abdu S, Bennie M, Bishop I et al. Payers endorse generics to enhance prescribing efficiency; impact and future implications, a case history approach. *Generics and Biosimilars Initiative Journal*. 2012;1(2):21–35.
- **88** Pettersson B, Hoffmann M, Wandell P, Levin LA. Utilization and costs of lipid modifying therapies following health technology assessment for the new reimbursement scheme in Sweden. *Health Policy*. 2012;**104**(1):84–91.
- **89** Little P, Stuart B, Francis N, Douglas E, Tonkin-Crine S, Anthierens S, et al. Effects of internet-based training on antibiotic prescribing rates for acute respiratory-tract infections: a multinational, cluster, randomised, factorial, controlled trial. *Lancet*. 2013;**382**(9899):1175–82.
- **90** Cals JW, Butler CC, Hopstaken RM, Hood K, Dinant GJ. Effect of point of care testing for C reactive protein and training in communication skills on antibiotic use in lower respiratory tract infections: cluster randomised trial. *British Medical Journal*. 2009;**338**:b1374.

- 91 Goossens H, Coenen S, Costers M, De Corte S, De Sutter A, Gordts B, et al. Achievements of the Belgian Antibiotic Policy Coordination Committee (BAPCOC). Euro Surveillance. 2008;13(46).
- 92 Formoso G, Paltrinieri B, Marata AM, Gagliotti C, Pan A, Moro ML, et al. Feasibility and effectiveness of a low cost campaign on antibiotic prescribing in Italy: community level, controlled, non-randomised trial. British Medical Journal. 2013;347:f5391.
- 93 Furst J, Cizman M, Mrak J, Kos D, Campbell S, Coenen S, et al. The influence of a sustained multifaceted approach to improve antibiotic prescribing in Slovenia during the past decade: findings and implications. Expert Review of Anti-infective Therapy. 2015;13(2):279-89.

- 1 Organisation for Economic Co-operation and Development. Health at a Glance 2011: OECD Indicators. Pharmaceutical expenditure. OECD Publishing. Available from: http://www.oecd.org/els/health-systems/49105858.pdf (last accessed 18 November 2015).
- 2 Kaplan W, Wirtz V, Mantel-Teeuwisse A, Stolk P, Duthey B, Laing R. Priority Medicines for Europe and the World 2013 Update. Available from: http://www.who.int/medicines/areas/priority_medicines/MasterDocJune28_FINAL_Web.pdf?ua=1 (lastaccessed 18 November 2015).
- **3** Godman B, Wettermark B, van Woerkom M, Fraeyman J, Alvarez-Madrazo S, Berg C, et al. Multiple policies to enhance prescribing efficiency for established medicines in Europe with a particular focus on demand-side measures: findings and future implications. *Frontiers in Pharmacology*. 2014;**5**:106.
- **4** Wettermark B. The intriguing future of pharmacoepidemiology. *European Journal of Clinical Pharmacology*. 2013;**69**(Suppl. 1):43–51.
- **5** Wettermark B, Persson ME, Wilking N, Kalin M, Korkmaz S, Hjemdahl P, et al. Forecasting drug utilization and expenditure in a metropolitan health region. *BMC Health Services Research*. 2010;**10**:128.
- **6** Holloway KA. Combating inappropriate use of medicines. *Expert Review of Clinical Pharmacology*. 2011;**4**(3):335–48.
- 7 Henshall C, Sansom L, Eichler H-G, Lemgruber A, Longson C, O'Rourke B, Tunis S. Understanding the role and evidence expectations of health technology assessment and coverage/payer bodies: what are they looking for, and how and why does this differ from what regulators require? *Therapeutic Innovation* & Regulatory Science. 2014;48 (3):341–6.

- **8** Paris V, Belloni A. Value in Pharmaceutical Pricing. OECD Health Working Papers, No. 63: OECD Publishing. Available from: http://dx.doi. org/10.1787/5k43jc9v6knx-en (last accessed 18 November 2015).
- **9** Pammolli F, Magazzini L, Riccaboni M. The productivity crisis in pharmaceutical R&D. *Nature Reviews Drug Discovery.* 2011;**10**(6):428–38.
- 10 Eichler HG, Baird L, Barker R, Bloechl-Daum B, Borlum-Kristensen F, Brown J, et al. From adaptive licensing to adaptive pathways: delivering a flexible life-span approach to bring new drugs to patients. *Clinical Pharmacology and Therapeutics*. 2015;97(3):234–46.
- 11 European Federation of Pharmaceutical Industries and Associations. Health & Growth: Evidence Compendium. Available from: http://www.efpia.eu/uploads/Modules/Documents/health-andgrowth_evidence-compendium.pdf (last accessed 18 November 2015).
- **12** Godman B, Finlayson AE, Cheema PK, Zebedin-Brandl E, Gutierrez-Ibarluzea I, Jones J, et al. Personalizing health care: feasibility and future implications. *BMC Medicine*. 2013;**11**:179.
- 13 Iskrov G, Stefanov R. Post-marketing access to orphan drugs: a critical analysis of health technology assessment and reimbursement decision-making considerations. *Orphan Drugs: Research and Reviews.* 2014;**4**:1–9.
- **14** Baird LG, Banken R, Eichler HG, Kristensen FB, Lee DK, Lim JC, et al. Accelerated access to innovative medicines for patients in need. *Clinical Pharmacology and Therapeutics*. 2014;**96**(5):559–71.
- **15** Forda SR, Bergström R, Chlebus M, Barker R, Andersen PH. Priorities for improving drug research development and regulation. *Nature Reviews Drug Discovery*. 2013;**12**:247–8.

- **16** Babar ZU, Francis S. Identifying priority medicines policy issues for New Zealand: a general inductive study. *British Medical Journal Open*. 2014;**4**(5):e004415.
- **17** Drews J. Drug discovery: a historical perspective. *Science*. 2000;**287**(5460):1960–4.
- **18** Lichtenberg F. Pharmaceutical innovation and longevity growth in 30 developing and high-income countries, 2000–2009. *Health Policy and Technology*. 2014;**3**:36–58.
- 19 World Health Organization. Database on life expectancy. Available from: http://www.who.int/gho/mortality_burden_disease/life_tables/situation_trends/en/ (last accessed 18 November 2015).
- **20** World Bank. Database on life expectancy at birth. Available from: http://www.who.int/gho/mortality_burden_disease/life_tables/hale/en/ (last accessed 18 November 2015).
- 21 Economic Intelligence Unit. Never too early: tackling chronic disease to extend healthy life years. Available from: https://www.ihpm.org/pdf/EIU-Abbott_TacklingChronicDisease_Web.pdf (last accessed 18 November 2015).
- **22** Cramer JA, Benedict A, Muszbek N, Keskinaslan A, Khan ZM. The significance of compliance and persistence in the treatment of diabetes, hypertension and dyslipidaemia: a review. *International Journal of Clinical Practice*. 2008;**62**(1):76–87.
- 23 Kiviniemi V, Peura P, Helin-Salmivaara A, Martikainen JE, Hartikainen J, Huupponen R, et al. Suboptimal use of statins at treatment initiation. *European Journal of Clinical Pharmacology*. 2011;67(9):971–3.
- **24** Godman B, Bishop I, Campbell SM, Malmstrom RE, Truter I. Quality and efficiency of statin prescribing across countries with a special focus on South Africa; findings and future implications. *Expert Review of Pharmacoeconomics & Outcomes Research*. 2015;**15**(2):323–30.
- 25 Pedersen TR, Kjekshus J, Berg K, Haghfelt T, Faergeman O, Faergeman G, et al. Randomised trial of cholesterol lowering in 4444 patients with coronary heart disease: the Scandinavian Simvastatin Survival Study (4S) 1994. *Atherosclerosis Supplements*. 2004;5(3):81–7.
- **26** Bellosta S, Paoletti R, Corsini A. Safety of statins: focus on clinical pharmacokinetics and drug interactions. *Circulation*. 2004;**109**(23 Suppl. 1):iii50–7.

- **27** Staffa JA, Chang J, Green L. Cerivastatin and reports of fatal rhabdomyolysis. *New England Journal of Medicine*. 2002;**346**(7):539–40.
- **28** Furberg CD, Pitt B. Withdrawal of cerivastatin from the world market. *Current Controlled Trials in Cardiovascular Medicine*. 2001;**2**(5):205–7.
- **29** Ewang-Emukowhate M, Wierzbicki AS. Lipid-lowering agents. *Journal of Cardiovascular Pharmacology and Therapeutics*. 2013;**18**(5):401–11.
- **30** Toth PP. Drug treatment of hyperlipidaemia: a guide to the rational use of lipid-lowering drugs. *Drugs*. 2010;**70**(11):1363–79.
- **31** Srinivasa Rao K, Prasad T, Mohanta GP, Manna PK. An overview of statins as hypolipidemic drugs. *International Journal of Pharmaceutical Sciences and Drug Research*. 2011;**3**(3):178–83.
- 32 Kim JH, Zamorano J, Erdine S, Pavia A, Al-Khadra A, Sutradhar S, et al. Reduction in cardiovascular risk using proactive multifactorial intervention versus usual care in younger (< 65 years) and older (>/= 65 years) patients in the CRUCIAL trial. *Current Medical Research and Opinion*. 2013;29(5):453–63.
- 33 Naci H, Brugts JJ, Fleurence R, Tsoi B, Toor H, Ades AE. Comparative benefits of statins in the primary and secondary prevention of major coronary events and all-cause mortality: a network meta-analysis of placebo-controlled and active-comparator trials. *European Journal of Preventive Cardiology*. 2013;20(4):641–57.
- 34 Shepherd J, Kastelein JJ, Bittner V, Deedwania P, Breazna A, Dobson S, et al. Intensive lipid lowering with atorvastatin in patients with coronary heart disease and chronic kidney disease: the TNT (Treating to New Targets) study. *Journal of the American College of Cardiology.* 2008;51(15):1448–54.
- **35** Bybee KA, Lee JH, O'Keefe JH. Cumulative clinical trial data on atorvastatin for reducing cardiovascular events: the clinical impact of atorvastatin. *Current Medical Research and Opinion*. 2008;**24**(4):1217–29.
- **36** Grabowski DC, Lakdawalla DN, Goldman DP, Eber M, Liu LZ, Abdelgawad T, et al. The large social value resulting from use of statins warrants steps to improve adherence and broaden treatment. *Health Affairs (Project Hope)*. 2012;**31**(10):2276–85.
- **37** Gotto AM Jr, Boccuzzi SJ, Cook JR, Alexander CM, Roehm JB, Meyer GS, et al. Effect of lovastatin on cardiovascular resource utilization and costs in the

- Air Force/Texas Coronary Atherosclerosis Prevention Study (AFCAPS/TexCAPS). AFCAPS/TexCAPS Research Group. *American Journal of Cardiology*. 2000;**86**(11):1176–81.
- 38 World Economic Forum and Harvard School of Public Health. The Global Economic Burden of Non-communicable Diseases. Available from: http://www3.weforum.org/docs/WEF_Harvard_HE_GlobalEconomicBurdenNonCommunicableDiseases_2011.pdf (last accessed 18 November 2015).
- 39 Suhrcke M, Urban D. Are cardiovascular diseases bad for economic growth? Available from: http://www.cesifo-group.de/portal/page/portal/DocBase_Content/WP/WP-CESifo_Working_Papers/wp-cesifo-2006/wp-cesifo-2006-11/cesifo1_wp1845.pdf (last accessed 18 November 2015).
- **40** European Commission; Directorate-General for Health and Consumers. Health of People of Working Age. Available from: http://ec.europa.eu/health/social_determinants/docs/final_full_ecorys_web.pdf (last accessed 18 November 2015).
- **41** Salomon JA, Wang H, Freeman MK, Vos T, Flaxman AD, Lopez AD, et al. Healthy life expectancy for 187 countries, 1990–2010: a systematic analysis for the Global Burden Disease Study 2010. *Lancet*. 2012;**380**(9859):2144–62.
- 42 European Commission; Directorate-General for Economic and Financial Affairs. The 2012 Ageing Report: Underlying Assumptions and Projection Methodologies Joint Report Prepared by the European Commission (DG ECFIN) and the Economic Policy Committee (AWG). Available from: http://ec.europa.eu/economy_finance/publications/european_economy/2011/pdf/ee-2011-4_en.pdf (last accessed 18 November 2015).
- **43** McKee M, Stuckler D, Martin-Moreno JM. Protecting health in hard times. *British Medical Journal (Clinical Research Edition)*. 2010;**341**:c5308.
- **44** Taylor L. NICE rejects 'wider societal benefit' test for new drugs. *PharmaTimes*. Available from: http://www.pharmatimes.com/article/14-01-26/NICE_rejects_wider_societal_benefit_test_for_new_drugs .aspx (last accessed 18 November 2015).
- **45** Scottish Medicines Consortium. PACE (Patient & Clinician Engagement) Overview Document. Available from: https://www.scottishmedicines.org.uk/files/PACE/PACE_Overview_Document_FINAL.pdf (last accessed 18 November 2015).

- 46 HM Government. Pharmaceutical Price Regulation Scheme (PPRS): Heads of Agreement. Available from: https://www.gov.uk/government/publications/pharmaceutical-price-regulation-scheme-pprsheads-of-agreement (last accessed 18 November 2015).
- **47** Sermet C, Andrieu V, Godman B, Van Ganse E, Haycox A, Reynier JP. Ongoing pharmaceutical reforms in France: implications for key stakeholder groups. *Applied Health Economics and Health Policy*. 2010;**8**(1):7–24.
- 48 EFPIA. Pharmaceutical Body EFPIA and Lithuanian Ministry of Health Galvanise Future Innovation and Improvements to Public Health with Landmark Joint Working Agreement. Available from: http://www.efpia.eu/mediaroom/190/43/Pharmaceutical-Body-EFPIA-and-Lithuanian-Ministry-of-Health-Galvanise-Future-Innovation-and-Improvements-to-Public-Health-with-Landmark-Joint-Working-Agreement (last accessed 18 November 2015).
- **49** Dymek C, Gingold J, Shanbhag A, Fridsma D, Yong PL. A national data infrastructure for patient-centered outcomes research. *Journal of Comparative Effectiveness Research*. 2015;**4**(1):75–87.
- 50 Cars T, Wettermark B, Malmstrom RE, Ekeving G, Vikstrom B, Bergman U, et al. Extraction of electronic health record data in a hospital setting: comparison of automatic and semi-automatic methods using anti-TNF therapy as model. *Basic & Clinical Pharmacology & Toxicology*. 2013;112(6):392–400.
- **51** Porter ME, Teusber EO. *Redefining Health Care: Creating Value-Based Competition on Results.* New York, Harvard Business School Press, 2006.
- 52 Lawyer P, Soderlund N, Kent J, Larsson S. Health reform should focus on outcomes, not costs. *Boston Consulting Group Perspectives*. Available from: https://www.bcgperspectives.com/content/articles/health_care_payors_providors_health_reform_should_focus_on_outcomes/ (last accessed 18 November 2015).
- **53** Porter ME. A strategy for health care reform toward a value-based system. *New England Journal of Medicine*. 2009;**361**(2):109–12.
- 54 Stausberg J, Hasford J. Drug-related admissions and hospital-acquired adverse drug events in Germany: a longitudinal analysis from 2003 to 2007 of ICD-10-coded routine data. *BMC Health Services Research*. 2011;11:134.

- 55 Pirmohamed M, James S, Meakin S, Green C, Scott AK, Walley TJ, et al. Adverse drug reactions as cause of admission to hospital: prospective analysis of 18 820 patients. *British Medical Journal (Clinical Research Edition)*. 2004;329(7456):15–19.
- **56** Brvar M, Fokter N, Bunc M, Mozina M. The frequency of adverse drug reaction related admissions according to method of detection, admission urgency and medical department specialty. *BMC Clinical Pharmacology*. 2009;**9**:8.
- **57** Rottenkolber D, Schmiedl S, Rottenkolber M, Farker K, Salje K, Mueller S, et al. Adverse drug reactions in Germany: direct costs of internal medicine hospitalizations. *Pharmacoepidemiology and Drug Safety*. 2011;**20**(6):626–34.
- **58** Miller I, Ashton-Chess J, Spolders H, Fert V, Ferrara J, Kroll W, et al. Market access challenges in the EU for high medical value diagnostic tests. *Personalised Medicine*. 2011;**8**:137–48.
- 59 Food and Drug Administration. Table of Pharma-cogenomic Biomarkers in Drug Labeling. Available from: http://www.fda.gov/Drugs/ScienceResearch/ResearchAreas/Pharmacogenetics/ucm083378.htm (last accessed 18 November 2015).
- **60** Abramson EL, Barron Y, Quaresimo J, Kaushal R. Electronic prescribing within an electronic health record reduces ambulatory prescribing errors. *Joint Commission Journal on Quality and Patient Safety/Joint Commission Resources*. 2011;**37**(10):470–8.
- **61** Troncoso A, Diogene E. Dabigatran and rivaroxaban prescription for atrial fibrillation in Catalonia, Spain: the need to manage the introduction of new drugs. *European Journal of Clinical Pharmacology*. 2014;**70**(2):249–50.
- **62** Bjorkhem-Bergman L, Andersen-Karlsson E, Laing R, Diogene E, Melien O, Jirlow M, et al. Interface management of pharmacotherapy. Joint hospital and primary care drug recommendations. *European Journal of Clinical Pharmacology*. 2013;**69**(Suppl. 1): 73–8.
- 63 European Federation of Pharmaceutical Industries and Associations. Health & Growth: Working Together for a Healthy Europe. A Vision Towards a Life Sciences Strategy for Europe. Brussels, European Federation of Pharmaceutical Industries and Associations, 2014. Available from: http://www.efpia.eu/uploads/documents/EFPIA-health&growth_MAN-

- IFESTO_V11_pbp.pdf (last accessed 18 November 2015).
- **64** Toumi M, Rémuzat C; Executive Agency for Health and Consumers. EU Pharmaceutical Expenditure Forecast. Available from: http://ec.europa.eu/health/healthcare/docs/creativ_ceutical_eu_pharmaceutical_expenditure_forecast.pdf (last accessed 18 November 2015).
- **65** Godman B, AbuelkhairM, Vitry A, Abdu S, Bennie M, Bishop I, et al. Payers endorse generics to enhance prescribing efficiency; impact and future implications, a case history approach. *Generics and Biosimilars Initiative Journal*. 2012;**1**(2):21–35.
- **66** Jack A. Balancing Big Pharma's books. *British Medical Journal (Clinical Research Edition)*. 2008;**336**(7641):418–19.
- **67** Haustein R, de Millas C, Höer H, Häussler B. Saving money in the European healthcare systems with biosimilars. *Generics and Biosimilars Initiative Journal*. 2012;**1**(3–4):120–6.
- **68** PharmaFutures. PharmaFutures Global Conclusions. Pathways to Value: Pharma in a Changing World. Available from: http://apps.who.int/medicinedocs/documents/s20202en/s20202en.pdf (last accessed 18 November 2015).
- **69** Henshall C, Schuller T. Health technology assessment, value-based decision making, and innovation. *International Journal of Technology Assessment in Health Care*. 2013;**29**(4):353–9.
- **70** van de Vooren K, Duranti S, Curto A, Garattini L. A critical systematic review of budget impact analyses on drugs in the EU countries. *Applied Health Economics and Health Policy*. 2014;**12**(1):33–40.
- 71 Godman B, Campbell S, Suh HS, Finlayson A, Bennie M, Gustafsson L. Ongoing measures to enhance prescribing efficiency across Europe: implications for other countries. *Journal of Health Technology Assessment*. 2013;1:27–42.
- 72 Carlson JJ, Gries KS, Yeung K, Sullivan SD, Garrison LP Jr. Current status and trends in performance-based risk-sharing arrangements between healthcare payers and medical product manufacturers. *Applied Health Economics and Health Policy*. 2014;12(3):231–8.
- 73 Ferrario A, Kanavos P. Managed entry agreements for pharmaceuticals: the European experience. Available from: http://core.ac.uk/download/

- pdf/16379320.pdf (last accessed 18 November 2015).
- 74 Morel T, Arickx F, Befrits G, Siviero P, van der Meijden C, Xoxi E, et al. Reconciling uncertainty of costs and outcomes with the need for access to orphan medicinal products: a comparative study of managed entry agreements across seven European countries. *Orphanet Journal of Rare Diseases*. 2013;8:198.
- **75** Grimaldi-Bensouda L, Zureik M, Aubier M, Humbert M, Levy J, Benichou J, et al. Does omalizumab make a difference to the real-life treatment of asthma exacerbations?: Results from a large cohort of patients with severe uncontrolled asthma. *Chest.* 2013;**143**(2):398–405.
- 76 National Institute of Health and Care Excellence. Omalizumab for treating severe persistent allergic asthma. Available from: https://www.nice.org.uk/ guidance/ta278 (last accessed 18 November 2015).
- 77 NBHW. Osteoporos, artros, inflammatorisk ryggsjukdom och ankyloserande spondylit, psoriasisartrit och reumatoid artrit. Available from: http:// www.socialstyrelsen.se/Lists/Artikelkatalog/ Attachments/18665/2012-5-1.pdf (last accessed 18 November 2015).
- 78 CVS Caremark. CVS caremark medication adherence report identifies significant opportunities for health care cost-savings across all 50 US states. Available from: http://www.prnewswire.com/news-releases/cvs-caremark-medication-adherence-report-identifies-significant-opportunities-for-health-care-cost-savings-across-all-50-us-states-213288371.html (last accessed 18 November 2015).
- 79 Business Wire. Humana and Pfizer form research partnership to improve health care delivery for seniors. Available from: http://www.businesswire.com/news/home/20111013006441/en/Humana-Pfizer-Form-Research-Partnership-Improve-Health (last accessed 18 November 2015).
- **80** Keegan BM. Natalizumab for multiple sclerosis: a complicated treatment. *Lancet Neurology*. 2011;**10**(8):677–8.
- **81** Kappos L, Bates D, Edan G, Eraksoy M, Garcia-Merino A, Grigoriadis N, et al. Natalizumab treatment for multiple sclerosis: updated recommendations for patient selection and monitoring. *Lancet Neurology*. 2011;**10**(8):745–58.

- **82** Raaschou P, Simard JF, Holmqvist M, Askling J. Rheumatoid arthritis, anti-tumour necrosis factor therapy, and risk of malignant melanoma: nationwide population based prospective cohort study from Sweden. *British Medical Journal (Clinical Research Edition)*. 2013;**346**:f1939.
- 83 International Society for Pharmacoeconomics and Outcomes Research. ISPOR Good Practices for Outcomes Research Index. Available from: http://www.ispor.org/workpaper/practices_index.asp (last accessed 18 November 2015).
- **84** Drummond M, Helfand M, Mullins CD. Note from the editors. *Medical Decision Making*. 2012;**32**(5):653–5.
- **85** Cosman F, de Beur SJ, LeBoff MS, Lewiecki EM, Tanner B, Randall S, Lindsay R. Clinician's guide to prevention and treatment of osteoporosis. *Osteoporosis International*. 2014;**25**(10):2359–81.
- **86** Wysowski DK. Reports of esophageal cancer with oral bisphosphonate use. *New England Journal of Medicine*. 2009;**360**(1):89–90.
- **87** Cardwell CR, Abnet CC, Cantwell MM, Murray LJ. Exposure to oral bisphosphonates and risk of esophageal cancer. *Journal of the American Medical Association*. 2010;**304**(6):657–63.
- **88** Green J, Czanner G, Reeves G, Watson J, Wise L, Beral V. Oral bisphosphonates and risk of cancer of oesophagus, stomach, and colorectum: case-control analysis within a UK primary care cohort. *British Medical Journal*. 2010;**341**:c4444.
- 89 Food and Drug Administration. FDA Drug Safety Communication: Ongoing Safety Review of Oral Osteoporosis Drugs (Bisphosphonates) and Potential Increased Risk of Esophageal Cancer. Available from: http://www.fda.gov/drugs/drugsafety/ucm263320.htm (last accessed 18 November 2015).
- 90 Food and Drug Administration. FDA Drug Safety Podcast for Healthcare Professionals: Ongoing Safety Review of Oral Osteoporosis Drugs (Bisphosphonates) and Potential Increased Risk of Esophageal Cancer. Available from: http://www.fda.gov/Drugs/ DrugSafety/DrugSafetyPodcasts/ucm264096.htm (last accessed 18 November 2015).
- **91** de la Maisonneuve COM. *Public Spending on Health and Long-Term Care: A New Set of Projections.* Paris, Organisation for Economic Co-operation and Development, 2013.

- 1 Franks ME, Macpherson GR, Figg WD. Thalidomide. *Lancet.* 2004;**363**(9423):1802–11.
- 2 Food and Drug Administration. Reviewer Guidance. Evaluating the Risks of Drug Exposure in Human Pregnancies. Food and Drug Administration, 2005. Available from: http://www.fda.gov/downloads/Drugs/.../Guidances/ucm071645.pdf (last accessed 18 November 2015).
- **3** Koren G. Medication Safety in Pregnancy and Breastfeeding: The Evidence-Based A-to-Z Clinician's Pocket Guide. New York, McGraw-Hill Medical, 2007.
- **4** Kallen B, Olausson PO. No increased risk of infant hypospadias after maternal use of loratadine in early pregnancy. *Interntaional Journal of Medical Science*. 2006;**3**(3):106–7.
- **5** Schwarz EB, Moretti ME, Nayak S, Koren G. Risk of hypospadias in offspring of women using loratadine during pregnancy: a systematic review and meta-analysis. *Drug Safety.* 2008;**31**(9):775–88.
- **6** Lupattelli A, Spigset O, Twigg MJ, Zagorodnikova K, Mårdby AC, Moretti ME, et al. Medication use in pregnancy: a cross-sectional, multinational web-based study. *British Medical Journal Open.* 2014;**4**(2):e004365.
- 7 Marchetti F, Romero M, Bonati M, Tognoni G. Use of psychotropic drugs during pregnancy. A report of the international co-operative drug use in pregnancy (DUP) study. Collaborative Group on Drug Use in Pregnancy (CGDUP). European Journal of Clinical Pharmacology. 1993;45(6):495–501.
- **8** Daw JR, Hanley GE, Greyson DL, Morgan SG. Prescription drug use during pregnancy in developed countries: a systematic review. *Pharmacoepidemiology* & Drug Safety. 2011;**20**(9):895–902.
- **9** Mitchell AA, Gilboa SM, Werler MM, Kelley KE, Louik C, Hernandez-Diaz S. Medication use during pregnancy, with particular focus on prescription

- drugs: 1976–2008. *American Journal of Obstetrics and Gynecology*. 2011;**205**(1):51 e1–8.
- 10 Lacroix I, Hurault C, Sarramon MF, Guitard C, Berrebi A, Grau M, et al. Prescription of drugs during pregnancy: a study using EFEMERIS, the new French database. *European Journal of Clinical Pharmacology*. 2009;65(8):839–46.
- **11** Kulaga S, Zargarzadeh AH, Berard A. Prescriptions filled during pregnancy for drugs with the potential of fetal harm. *BJOG*. 2009;**116**(13):1788–95.
- **12** Cleary BJ, Butt H, Strawbridge JD, Gallagher PJ, Fahey T, Murphy DJ. Medication use in early pregnancy-prevalence and determinants of use in a prospective cohort of women. *Pharmacoepidemiology* & Drug Safety. 2010;**19**(4):408–17.
- 13 Engeland A, Bramness JG, Daltveit AK, Ronning M, Skurtveit S, Furu K. Prescription drug use among fathers and mothers before and during pregnancy. A population-based cohort study of 106 000 pregnancies in Norway 2004–2006. *British Journal of Clinical Pharmacology.* 2008;65(5):653–60.
- 14 Hardy JR, Leaderer BP, Holford TR, Hall GC, Bracken MB. Safety of medications prescribed before and during early pregnancy in a cohort of 81,975 mothers from the UK General Practice Research Database. *Pharmacoepidemiology & Drug Safety.* 2006;15(8):555–64.
- **15** Piper JM, Mitchel EF Jr. Prenatal exposure to prescribed drugs in Tennessee Medicaid, 1983–1988. *Paediatric & Perinatal Epidemiology*. 1991;**5**(4):402–9.
- **16** Buitendijk S, Bracken MB. Medication in early pregnancy: prevalence of use and relationship to maternal characteristics. *American Journal of Obstetrics and Gynecology.* 1991;**165**(1):33–40.
- **17** Donati S, Baglio G, Spinelli A, Grandolfo ME. Drug use in pregnancy among Italian women. *European Journal of Clinical Pharmacology*. 2000;**56**(4):323–8.

- **18** Larivaara P, Hartikainen AL, Rantakallio P. Use of psychotropic drugs and pregnancy outcome. *Journal of Clinical Epidemiology*. 1996;**49**(11):1309–13.
- 19 Bonassi S, Magnani M, Calvi A, Repetto E, Puglisi P, Pantarotto F, et al. Factors related to drug consumption during pregnancy. *Acta Obstetricia et Gynecologica Scandinavica*. 1994;73(7):535–40.
- **20** Rubin JD, Ferencz C, Loffredo C. Use of prescription and non-prescription drugs in pregnancy. The Baltimore-Washington Infant Study Group. *Journal of Clinical Epidemiology*. 1993;**46**(6):581–9.
- 21 Bonati M, Bortolus R, Marchetti F, Romero M, Tognoni G. Drug use in pregnancy: an overview of epidemiological (drug utilization) studies. *European Journal of Clinical Pharmacology*. 1990;38(4):325–8.
- 22 De Vigan C, De Walle HE, Cordier S, Goujard J, Knill-Jones R, Ayme S, et al. Therapeutic drug use during pregnancy: a comparison in four European countries. OECM Working Group. Occupational Exposures and Congenital Anomalies. *Journal of Clinical Pharmacology*. 1999;52(10):977–82.
- **23** Collaborative Group on Drug Use in Pregnancy (CGDUP). Medication during pregnancy: an intercontinental cooperative study. *International Journal of Gynaecology and Obstetrics*. 1992;**39**(3):185–96.
- **24** EURAP Study Group. Utilization of antiepileptic drugs during pregnancy: comparative patterns in 38 countries based on data from the EURAP registry. *Epilepsia*. 2009;**50**(10):2305–9.
- **25** Ystrom E, Vollrath ME, Nordeng H. Effects of personality on use of medications, alcohol, and cigarettes during pregnancy. *European Journal of Clinical Pharmacology.* 2012;**68**(5):845–51.
- 26 Schaefer C, Peters PWJ, Miller RK. Drugs During Pregnancy and Lactation: Treatment Options and Risk Assessment, 2nd edn. Amsterdam, London, Elsevier, 2007.
- 27 Soriano LC, Bateman BT, García Rodríguez LA, Hernández-Díaz S. Prescription of antihypertensive medications during pregnancy in the UK. *Pharmacoepidemiology & Drug Safety*. 2014;23(10):1051–8.
- 28 Crijns HJ, van Rein N, Gispen-de Wied CC, Straus SM, de Jong-van den Berg LT. Prescriptive contraceptive use among isotretinoin users in the Netherlands in comparison with non-users: a drug utilisation study. *Pharmacoepidemiology & Drug Safety*. 2012;21(10):1060−6.

- **29** Daw JR, Mintzes B, Law MR, Hanley GE, Morgan SG. Prescription drug use in pregnancy: a retrospective, population-based study in British Columbia, Canada (2001–2006). *Clinical Therapy*. 2012;**34**(1):239–49, e2.
- **30** Lacroix I, Damase-Michel C, Lapeyre-Mestre M, Montastruc JL. Prescription of drugs during pregnancy in France. *Lancet*. 2000;**356**(9243):1735–6.
- 31 Olesen C, Thrane N, Henriksen TB, Ehrenstein V, Olsen J. Associations between socio-economic factors and the use of prescription medication during pregnancy: a population-based study among 19 874 Danish women. European Journal of Clinical Pharmacology. 2006;62(7):547–53.
- **32** Wen SW, Yang T, Krewski D, Yang Q, Nimrod C, Garner P, et al. Patterns of pregnancy exposure to prescription FDA C, D and X drugs in a Canadian population. *Journal of Perinatology*. 2008;**28**(5):324–9.
- **33** Feldman Y, Koren G, Mattice K, Shear H, Pellegrini E, MacLeod SM. Determinants of recall and recall bias in studying drug and chemical exposure in pregnancy. *Teratology*. 1989;**40**(1):37–45.
- **34** Addis A, Sharabi S, Bonati M. Risk classification systems for drug use during pregnancy: are they a reliable source of information? *Drug Safety*. 2000;**23**(3):245–53.
- 35 Olesen C, Sorensen HT, de Jong-van den Berg L, Olsen J, Steffensen FH. Prescribing during pregnancy and lactation with reference to the Swedish classification system. A population-based study among Danish women. The Euromap Group. *Acta Obstetricia et Gynecologica Scandinavica*. 1999;78(8):686–92.
- 36 European Medicines Agency. Guideline on Risk Assessment of Medicinal Products on Human Reproduction and Lactation: From Data to Labelling. Available from: http://www.ema.europa.eu/docs/en_GB/document_library/Scientific_guideline/2009/09/WC500003307.pdf (last accessed 18 November 2015).
- **37** Huybrechts KF, Palmsten K, Mogun H, Kowal M, Avorn J, Setoguchi-Iwata S, et al. National trends in antidepressant medication treatment among publicly insured pregnant women. *General Hospital Psychiatry*. 2013;**35**(3):265–71.
- **38** Bakker MK, Kolling P, van den Berg PB, de Walle HE, de Jong van den Berg LT. Increase in use of selective serotonin reuptake inhibitors in pregnancy during the last decade, a population-based cohort

- study from the Netherlands. *British Journal of Clinical Pharmacology*. 2008;**65**(4):600–6.
- McManus P, Mant A, Mitchell PB, Montgomery WS, Marley J, Auland ME. Recent trends in the use of antidepressant drugs in Australia, 1990–1998. *Medical Journal of Australia*. 2000;**173**(9):458–61.
- **40** Charlton R, Jordan S, Pierini A, Garne E, Neville A, Hansen A, et al. Selective serotonin reuptake inhibitor prescribing before, during and after pregnancy: a population-based study in six European regions. *BJOG*. 2015;**122**(7):1010–20.
- Heikkila AM. Antibiotics in pregnancy a prospective cohort study on the policy of antibiotic prescription. *Annals of Medicine*. 1993;**25**(5):467–71.
- de Jonge L, Bos HJ, van Langen IM, de Jong-van den Berg LT, Bakker MK. Antibiotics prescribed before, during and after pregnancy in the Netherlands: a drug utilization study. *Pharmacoepidemiology & Drug Safety.* 2014;**23**(1):60–8.
- Santos F, Oraichi D, Berard A. Prevalence and predictors of anti-infective use during pregnancy. *Pharmacoepidemiology & Drug Safety.* 2010;**19**(4):418–27.
- Källén BA, Otterblad Olausson P, Danielsson BR. Is erythromycin therapy teratogenic in humans? *Reproductive Toxicology.* 2005;**20**(2):209–14.
- **45** Romoren M, Lindbaek M, Nordeng H. Pregnancy outcome after gestational exposure to erythromycin-a population-based register study from Norway. *British Journal of Clinical Pharmacology*. 2012;**74**(6):1053–62.
- Osterberg L, Blaschke T. Adherence to medication. *New England Journal of Medicine*. 2005;**353**(5): 487–97.
- Vermeire E, Hearnshaw H, Van Royen P, Denekens J. Patient adherence to treatment: three decades of research. A comprehensive review. *Journal of Clinical Pharmacy and Therapeutics*. 2001;**26**(5):331–42.
- Lupattelli A, Spigset O, Nordeng H. Adherence to medication for chronic disorders during pregnancy: results from a multinational study. *International Journal of Clinical Pharmacy*. 2014;**36**(1):145–53.
- Kennedy J. Herb and supplement use in the US adult population. *Clinical Therapy*. 2005;**27**(11):1847–58.
- Hall HG, Griffiths DL, McKenna LG. The use of complementary and alternative medicine by pregnant women: a literature review. *Midwifery*. 2011;**27**(6):817–24.

- Kennedy DA, Lupattelli A, Koren G, Nordeng H. Herbal medicine use in pregnancy: results of a multinational study. *BMC Complementary and Alternative Medicine*. 2013;**13**:355.
- Crijns I, Bos J, Knol M, Straus S, de Jong-van den Berg L. Paternal drug use: before and during pregnancy. *Expert Opinon on Drug Safety*. 2012;**11**(4):513–18.
- 53 Malm H, Martikainen J, Klaukka T, Neuvonen PJ. Prescription drugs during pregnancy and lactation a Finnish register-based study. European Journal of Clinical Pharmacology. 2003;59(2):127–33.
- Andrade SE, Gurwitz JH, Davis RL, Chan KA, Finkelstein JA, Fortman K, et al. Prescription drug use in pregnancy. *American Journal of Obstetrics and Gynecology*. 2004;**191**(2):398–407.
- Hurault-Delarue C, Lacroix I, Vidal S, Montastruc JL, Damase-Michel C. [Drugs in pregnancy: study in the EFEMERIS database (2004 to 2008)]. *Gynecologie, Obstetrique & Fertilitie*. 2011;**39**(10):554−8.
- **56** Bateman BT, Hernandez-Diaz S, Huybrechts KF, Palmsten K, Mogun H, Ecker JL, et al. Patterns of outpatient antihypertensive medication use during pregnancy in a Medicaid population. *Hypertension*. 2012;**60**(4):913–20.
- Piper JM, Baum C, Kennedy DL. Prescription drug use before and during pregnancy in a Medicaid population. *American Journal of Obstetrics and Gynecology*. 1987;**157**(1):148–56.
- Sambamoorthi U, Akincigil A, McSpiritt E, Crystal S. Zidovudine use during pregnancy among HIV-infected women on Medicaid. *Journal of Acquired Immune Deficiency Syndrome*. 2002;**30**(4):429–39.
- **59** Charlton RA, Cunnington MC, de Vries CS, Weil JG. Data resources for investigating drug exposure during pregnancy and associated outcomes: the General Practice Research Database (GPRD) as an alternative to pregnancy registries. *Drug Safety*. 2008;**31**(1):39–51.
- 60 Sharma P, Parekh A, Uhl K. An innovative approach to determine fetal risk: the FDA Office of Women's Health pregnancy exposure registry web listing. *Womens Health Issues.* 2008;18(4):226–8.
- Schaefer C, Hannemann D, Meister R. Post-marketing surveillance system for drugs in pregnancy 15 years experience of ENTIS. *Reproductive Toxicology*. 2005;**20**(3):331–43.

- 4
- **62** Nava-Ocampo AA, Koren G. Human teratogens and evidence-based teratogen risk counseling: the Motherisk approach. *Clinical Obstetrics and Gynecology*. 2007;**50**(1):123–31.
- **63** Hardy JB. The Collaborative Perinatal Project: lessons and legacy. *Annals of Epidemiology*. 2003;**13**(5):303–11.
- **64** Heinonen OP, Slone D, Shapiro S. *Birth Defects and Drugs in Pregnancy*. Littleton, MA, Publishing Sciences Group, 1977.
- **65** Mitchell AA, Cottler LB, Shapiro S. Effect of questionnaire design on recall of drug exposure in pregnancy. *American Journal of Epidemiology*. 1986;**123**(4):670–6.
- **66** Rockenbauer M, Olsen J, Czeizel AE, Pedersen L, Sorensen HT. Recall bias in a case-control surveillance system on the use of medicine during pregnancy. *Epidemiology*. 2001;**12**(4):461–6.
- 67 Mackenzie SG, Lippman A. An investigation of report bias in a case-control study of pregnancy outcome. *American Journal of Epidemiology*. 1989;129(1):65–75.
- **68** Wettermark B, Zoega H, Furu K, Korhonen M, Hallas J, Norgaard M, et al. The Nordic prescription databases as a resource for pharmacoepidemiological research a literature review. *Pharmacoepidemiology & Drug Safety*. 2013;**22**(7):691−9.
- **69** Stephansson O, Granath F, Svensson T, Haglund B, Ekbom A, Kieler H. Drug use during pregnancy in Sweden assessed by the Prescribed Drug Register and the Medical Birth Register. *Clinical Epidemiology*. 2011;**3**:43–50.

- 70 EUROmediCAT website: www.euromedicat.eu.
- **71** van Gelder MM, Bretveld RW, Roeleveld N. Web-based questionnaires: the future in epidemiology? *American Journal of Epidemiology*. 2010;**172**(11):1292–8.
- **72** Eysenbach G. Improving the quality of Web surveys: the Checklist for Reporting Results of Internet E-Surveys (CHERRIES). *Journal of Medical Internet Research*. 2004;**6**(3):e34.
- 73 Altman DG. Practical Statistics for Medical Research. London, Chapman & Hall, 1991.
- **74** Margulis AV, Setoguchi S, Mittleman MA, Glynn RJ, Dormuth CR, Hernandez-Diaz S. Algorithms to estimate the beginning of pregnancy in administrative databases. *Pharmacoepidemiology & Drug Safety*. 2013;**22**(1):16–24.
- **75** Skurtveit S, Selmer R, Tverdal A, Furu K, Nystad W, Handal M. Drug exposure: inclusion of dispensed drugs before pregnancy may lead to underestimation of risk associations. *Journal of Clinical Epidemiology*. 2013;**66**(9):964–72.
- 76 Cohen LS, Altshuler LL, Harlow BL, Nonacs R, Newport DJ, Viguera AC, et al. Relapse of major depression during pregnancy in women who maintain or discontinue antidepressant treatment. *Journal of the American Medical Association*. 2006;295(5):499–507.
- 77 van Gelder MM, van Rooij IA, de Walle HE, Roeleveld N, Bakker MK. Maternal recall of prescription medication use during pregnancy using a paperbased questionnaire: a validation study in the Netherlands. *Drug Safety.* 2013;**36**(1):43–54.

- 1 Kearns GL, Abdel-Rahman SM, Alander SW, Blowey DL, Leeder JS, Kauffman RE. Developmental pharmacology drug disposition, action, and therapy in infants and children. *New England Journal of Medicine*. 2003;**349**:1157–67.
- 2 European Medicines Agency. 2001. Note for Guidance on Clinical Investigation of Medicinal Products in the Paediatric Population. Available from: http://www.ema.europa.eu/docs/en_GB/document_library/Scientific_guideline/2009/09/WC500003459.pdf (last accessed 18 November 2015).
- **3** Liu L, Johnson HL, Cousens S, Perin J, Scott S, Lawn JE, et al.; Child Health Epidemiology Reference Group of WHO and UNICEF. Global, regional, and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. *Lancet*. 2012;**379**(9832):2151–61.
- **4** Shirkey H. Therapeutic orphans. *Journal of Pediatrics*. 1968;**72**(1):119–20.
- **5** Shirkey HC. Therapeutic orphans everybody's business. *Annals of Pharmacotherapy*. 2006;**40**(6):1174.
- 6 European Commission. Regulation (EC) No 1901/2006 of the European Parliament and of the Council of 12 December 2006 on medicinal products for paediatric use and amending Regulation (EEC) No 1768/92, Directive2001/20/EC, Directive 2001/83/EC and Regulation (EC) No 726/2004. Available from: http://ec.europa.eu/health/files/eudralex/vol-1/reg_2006_1901/reg_2006_1901_en.pdf (last accessed 18 November 2015).
- 7 Food and Drug Administration Safety and Innovation Act (FDASIA). Available from: http://www.fda.gov/RegulatoryInformation/Legislation/SignificantAmendmentstotheFDCAct/FDASIA/ucm20027187.htm (last accessed 18 November 2015).

- **8** Neubert A, Sturkenboom MC, Murray ML, Verhamme KM, Nicolosi A, Giaquinto C, et al. Databases for pediatric medicine research in Europe assessment and critical appraisal. *Pharmacoepidemiology & Drug Safety.* 2008;**17**(12):1155–67.
- **9** WHO Collaborating Centre for Drug Statistics Methodology. Guidelines for ATC Classification and DDD Assignment 2013. Available from: http://www.whocc.no/filearchive/publications/1_2013guidelines.pdf (last accessed 18 November 2015).
- 10 Liem TBY, Heerdink ER, Egberts ACG, Rademaker CMA. Quantifying antibiotic use in paediatrics: a proposal for neonatal DDDs. European Journal of Clinical Microbiology and Infectious Disease. 2010;29(10):1301–3.
- 11 Valcourt K, Norozian F, Lee H, Raszynski A, Torbati D, Totapally BR. Drug use density in critically ill children and newborns: analysis of various methodologies. *Pediatric Critical Care Medicine*. 2009;10(4):495–9.
- **12** Sequi M, Campi R, Clavenna A, Bonati M.Methods in pharmacoepidemiology: a review of statistical analyses and data reporting in pediatric drug utilization studies. *European Journal of Clinical Pharmacology*. 2013;**69**(3):599–604.
- **13** Kimland E, Odlind V. Off-label drug use in pediatric patients. *Clinical Pharmacology and Therapeutics*. 2012;**91**(5):796–801.
- 14 Pandolfini C, Kaguelidou F, Sequi M, Jacqz-Aigrain E, Choonara I, Turner MA, et al. Wide intra- and inter-country variability in drug use and dosage in very-low-birth-weight newborns with severe infections. *European Journal of Clinical Pharmacology*. 2013;69(4):1031–6.
- **15** Ceci A, Felisi M, Baiardi P, Bonifazi F, Catapano M, Giaquinto C, et al. Medicines for children licensed by the European Medicines Agency (EMEA): the balance after 10 years. *European Journal of Clinical Pharmacology*. 2006;**62**(11):947–52.

- **16** Laughon MM, Avant D, Tripathi N, Hornik CP, Cohen-Wolkowiez M, Clark RH, et al. Drug labeling and exposure in neonates. *Journal of the American Medical Association Pediatrics*. 2014;**168**(2):130–6.
- **17** American Academy of Pediatrics. Off-label use of drugs in children. *Pediatrics*. 2014;**133**(3): 563 –7.
- **18** Pandolfini C, Bonati M. A literature review on off-label drug use in children. *European Journal of Paediatrics*. 2005;**164**(9):552–8.
- 19 Food and Drug Administration. 'Off-Label' and Investigational Use Of Marketed Drugs, Biologics, and Medical Devices Information Sheet. Available from: http://www.fda.gov/RegulatoryInformation/Guidances/ucm126486.htm (last accessed 18 November 2015).
- **20** Neubert A, Wong IC, Bonifazi A, Catapano M, Felisi M, Baiardi P, et al. Defining off-label and unlicensed use of medicines for children: results of a Delphi survey. *Pharmacology Research*. 2008;**58**(5–6):316–22.
- **21** Mason J, Pirmohamed M, Nunn T. Off-label and unlicensed medicine use and adverse drug reactions in children: a narrative review of the literature. *European Journal of Clinical Pharmacology*.2012;**68**(1):21–8.
- **22** Bellis JR, Kirkham JJ, Thiesen S, Conroy EJ, Bracken LE, Mannix HL, et al. Adverse drug reactions and off-label and unlicensed medicines in children: a nested case-control study of inpatients in a pediatric hospital. *BMC Medicine*. 2013;**11**:238.
- 23 Haslund-Krog S, Mathiasen R, Christensen HR, Holst H. The impact of legislation on drug substances used off-label in paediatric wards-a nationwide study. *European Journal of Clinical Pharmacology*. 2014;70(4):445–52.
- 24 Neubert A, Dormann H, Weiss J, Egger T, Criegee-Rieck M, Rascher W, et al. The impact of unlicensed and off-label drug use on adverse drug reactions in paediatric patients. *Drug Safety*. 2004;27(13):1059–67.
- **25** Knopf H, Wolf IK, Sarganas G, Zhuang W, Rascher W, Neubert A. Off-label medicine use in children and adolescents: results of a population-based study in Germany. *BMC Public Health*. 2013;**13**(1):631.
- **26** Sturkenboom MC, Verhamme KM, Nicolosi A, Murray ML, Neubert A, Caudri D, et al. Drug use in children: cohort study in three European countries. *British Medical Journal*. 2008;**337**:a2245.
- **27** Neubert A, Verhamme K, Murray ML, Picelli G, Hsia Y, Sen FE, et al. The prescribing of analgesics and

- non-steroidal anti-inflammatory drugs in paediatric primary care in the UK, Italy and the Netherlands. *Pharmacology Research.* 2010;**62**(3):243–8.
- 28 Sen EF, Verhamme KM, Neubert A, Hsia Y, Murray M, Felisi M, et al. Assessment of pediatric asthma drug use in three European countries; a TEDDY study. *European Journal of Paediatrics*. 2011;170(1):81–92.
- **29** Hsia Y, Neubert A, Sturkenboom MC, Murray ML, Verhamme KM, Sen F, et al. Comparison of antie-pileptic drug prescribing in children in three European countries. *Epilepsia*. 2010;**51**(5):789–96.
- **30** Weinstein SJ, House SA, Chang CH, Wasserman JR, Goodman DC, Morden NE. Small geographic area variations in prescription drug use. *Pediatrics*. 2014;**134**(3):563–70.
- **31** Chai G, Governale L, McMahon AW, Trinidad JP, Staffa J, Murphy D. Trends of outpatient prescription drug utilization in US children, 2002–2010. *Pediatrics*. 2012;**130**(1):23–31.
- **32** Olsson J, Kimland E, Pettersson S, Odlind V. Paediatric drug use with focus on off-label prescriptions in Swedish outpatient care a nationwide study. *Acta Paediatrica*. 2011;**100**(9):1272–5.
- **33** Feudtner C, Dai D, Faerber J, Metjian TA, Luan X. Pragmatic estimates of the proportion of pediatric inpatients exposed to specific medications in the USA. *Pharmacoepidemiology & Drug Safety*. 2013;**22**(8):890–8.
- **34** Kimland E, Nydert P, Odlind V, Böttiger Y, Lindemalm S. Paediatric drug use with focus on off-label prescriptions at Swedish hospitals a nationwide study. *Acta Paediatrica*. 2012;**101**(7):772–8.
- 35 Lass J, Käär R, Jõgi K, Varendi H, Metsvaht T, Lutsar I. Drug utilisation pattern and off-label use of medicines in Estonian neonatal units. *European Journal of Clinical Pharmacology*. 2011;67(12):1263–71.
- **36** Santos DB, Clavenna A, Bonati M, Coelho HL. Off-label and unlicensed drug utilization in hospitalized children in Fortaleza, Brazil. *European Journal of Clinical Pharmacology*. 2008;**64**(11):1111–18.
- **37** Flores-Pérez C, Flores-Pérez J, Juárez-Olguín H, Barranco-Garduño LM. Frequency of drug consumption and lack of pediatric formulations. *Acta Pediátrica de México*. 2008;**29**(1):16–20.
- 38 Shankar PR, Upadhyay DK, Subish P, Dubey AK, Mishra P. Prescribing patterns among paediatric

- inpatients in a teaching hospital in western Nepal. *Singapore Medical Journal*. 2006;**47**(4):261–5.
- Chirdkiatgumchai V, Xiao H, Fredstrom BK, Adams RE, Epstein JN, Shah SS, Brinkman WB, Kahn RS, Froehlich TE. National trends in psychotropic medication use in young children: 1994–2009. *Pediatrics*. 2013;**132**(4):615–23.
- Karanges EA, Stephenson CP, McGregor IS. Longitudinal trends in the dispensing of psychotropic medications in Australia from 2009-2012: focus on children, adolescents and prescriber specialty. *Australian and New Zealand Journal of Psychiatry*. 2014;**48**(10):917–31.
- Walkup, J (The Work Group on Quality Issues). Practice parameter on the use of psychotropic medication in children and adolescents. *Journal of the American Academy of Child & Adolescent Psychiatry*. 2009;**48**(9):961–73.
- **42** Faber A, de Jong-van den Berg LT, van den Berg PB, Tobi H. Psychotropic co-medication among stimulant-treated children in The Netherlands. *Journal of Child and Adolescent Psychopharmacology*. 2005;**15**(1):38–43.
- Clavenna A, Rossi E, Derosa M, Bonati M. Use of psychotropic medications in Italian children and adolescents. *European Journal of Paediatrics*. 2007;**166**(4):339–47.
- Clavenna A, Bonati M, Rossi E, De RM. Increase in non-evidence based use of antidepressants in children is cause for concern. *British Medical Journal*. 2004;**328**(7441):711–12.

- Clavenna A, Bonati M. Differences in antibiotic prescribing in paediatric outpatients. *Archives of Disease in Childhood*. 2011;**96**(6):590–5.
- Holstiege J, Schink T, Molokhia M, Mazzaglia G, Innocenti F, Oteri A, et al. Systemic antibiotic prescribing to paediatric outpatients in 5 European countries: a population-based cohort study. *BMC Pediatrics*. 2014;**14**:174.
- Vaz LE, Kleinman KP, Raebel MA, Nordin JD, Lakoma MD, Dutta-Linn MM, Finkelstein JA. Recent trends in outpatient antibiotic use in children. *Pediatrics*. 2014;**133**(3):375–85.
- **48** Rashed AN, Wong IC, Wilton L, Tomlin S, Neubert A. Drug Utilisation Patterns in Children Admitted to a Paediatric General Medical Ward in Five Countries. Drugs Real World Outcomes. **2015**;**2**(4): 397–410.
- Amadeo B, Zarb P, Muller A, Drapier N, Vankerckhoven V, Rogues AM, et al.; ESAC III Hospital Care Subproject Group. European Surveillance of Antibiotic Consumption (ESAC) point prevalence survey 2008: paediatric antimicrobial prescribing in 32 hospitals of 21 European countries. *Journal of Antimicrobial Chemotherapy*. 2010;**65**(10):2247–52.
- Versporten A, Sharland M, Bielicki J, Drapier N, Vankerckhoven V, Goossens H; ARPEC Project Group Members. The antibiotic resistance and prescribing in European Children project: a neonatal and pediatric antimicrobial web-based point prevalence survey in 73 hospitals worldwide. *Pediatric Infectious Disease Journal*. 2013;32(6):e242–53.

- 1 United Nations, Department of Economic and Social Affairs, Population Division. World Population Ageing 2013. ST/ESA/SER.A/348. Available from: http://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2013.pdf (last accessed 18 November 2015).
- 2 World Health Organization. Good Health Adds Life to Years. Global Brief for World Health Day 2012. Available from: http://whqlibdoc.who.int/hq/2012/WHO_DCO_WHD_2012.2_eng.pdf (last accessed 18 November 2015).
- **3** Barnett K, Mercer SW, Norbury M, Watt G, Wyke S, Guthrie B. Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. *Lancet*. 2012;**380**(9836):37–43.
- **4** Inouye SK, Studenski S, Tinetti ME, Kuchel GA. Geriatric syndromes: clinical, research, and policy implications of a core geriatric concept. *Journal of the American Geriatric Society.* 2007;**55**(5):780–91.
- **5** Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly people. *Lancet*. 2013;**381**:752–62.
- **6** Davies EA, O'Mahony MS. Adverse drug reactions in special populations the elderly. *British Journal of Clinical Pharmacology.* 2015;**80**(4):796–807.
- **7** Onder G, Carpenter I, Finne-Soveri H, Gindin J, Frijters D, Henrard JC, et al.; SHELTER project. Assessment of nursing home residents in Europe: the Services and Health for Elderly in Long TERm care (SHELTER) study. *BMC Health Services Research*. 2012;**12**:5.
- **8** Duerden M, Avery T, Payne R. *Polypharmacy and Medicines Optimization*. London, King's Fund, 2013.
- **9** Alldred DP, Raynor DK, Hughes C, Barber N, Chen TF, Spoor P. Interventions to optimise prescribing for older people in care homes. *Cochrane Database of Systematic Reviews*. 2013.28;2:CD009095.

- 10 Patterson SM, Cadogan CA, Kerse N, Cardwell CR, Bradley MC, Ryan C, Hughes C. Interventions to improve the appropriate use of polypharmacy for older people. *Cochrane Database of Systematic Reviews*. 2014;10:CD008165.
- 11 Thomas R, Huntley AL, Mann M, Huws D, Elwyn G, Paranjothy S, Purdy S. Pharmacist-led interventions to reduce unplanned admissions for older people: a systematic review and meta-analysis of randomised controlled trials. *Age and Ageing*. 2014;43(2):174–87.
- **12** Kaufman DW, Kelly JP, Rosenberg L, Anderson TE, Mitchell AA. Recent patterns of medication use in the ambulatory adult population of the United States: the Slone survey. *Journal of the American Medical Association*. 2002;**287**(3):337–44.
- 13 Centers for Disease Control and Prevention. NCHS Data Brief No. 42. Prescription Drug Use Continues to Increase: US Prescription Drug Data for 2007– 2008. Available from: http://www.cdc.gov/nchs/ data/databriefs/db42.pdf (last accessed 18 November 2015).
- 14 Moen J, Antonov K, Larsson CA, Lindblad U, Nilsson JL, Råstam L, Ring L. Factors associated with multiple medication use in different age groups. Annals of Pharmacotherapy. 2009;43(12):1978–85.
- **15** Schwabe U., Paffrath D. [Arzneiverordnungsreport]. Berlin, Springer, 2014.
- **16** Jyrkkä, J. Drug Use and Polypharmacy in Elderly Persons. Publications of the University of Eastern Finland. Dissertations in Health Sciences 47. 2011.
- 17 Lernfelt B, Samuelsson O, Skoog I, Landahl S. Changes in drug treatment in the elderly between 1971 and 2000. *European Journal of Clinical Pharmacology*. 2003;**59**(8–9):637–44.
- 18 Slone Epidemiology Center. Patterns of Medication Use in the United States 2006. Available from: http://www.bu.edu/slone/files/2012/11/Slone

- SurveyReport2006.pdf (last accessed 18 November 2015).
- **19** Boyd CM, Darer J, Boult C, Fried LP, Boult L, Wu AW. Clinical practice guidelines and quality of care for older patients with multiple comorbid diseases: implications for pay for performance. *Journal of the American Medical Association*. 2005;**294**(6):716–24.
- **20** Rochon PA, Gurwitz JH. Optimising drug treatment for elderly people: the prescribing cascade. *British Medical Journal*. 1997;**315**:1096–9.
- **21** Caughey GE, Roughead EE, Pratt N, Shakib S, Vitry AI, Gilbert AL. Increased risk of hip fracture in the elderly associated with prochlorperazine: is a prescribing cascade contributing? *Pharmacoepidemiology & Drug Safety.* 2010;**19**:977–82.
- **22** Steinman MA, Landefeld CS, Rosenthal GE, Berthenthal D, Sen S, Kaboli PJ. Polypharmacy and prescribing quality in older people. *Journal of the American Geriatric Society*. 2006;**54**(10):1516–23.
- **23** Hajjar ER, Cafiero AC, Hanlon JT. Polypharmacy in elderly patients. *American Journal of Geriatric Pharmacotherapy*. 2007;**5**(4):345–51.
- **24** Jyrkkä J, Vartiainen L, Hartikainen S, Sulkava R, Enlund H. Increasing use of medicines in elderly persons: a five-year follow-up of the Kuopio 75+Study. *European Journal of Clinical Pharmacology*. 2006;**62**(2):151–8.
- 25 Nobili A, Franchi C, Pasina L, Tettamanti M, Baviera M, Monesi L, et al. Drug utilization and polypharmacy in an Italian elderly population: the EPI-FARM-elderly project. *Pharmacoepidemiology and Drug Safety*. 2011;20(5):488–96.
- **26** Qato DM, Alexander GC, Conti RM, Johnson M, Schumm P, Lindau ST. Use of prescription and over-the-counter medications and dietary supplements among older adults in the United States. *Journal of the American Medical Association*. 2008;300(24):2867–78.
- **27** Kim H-A, Shin J-Y, Kim M-H, Park B-J. Prevalence and predictors of polypharmacy among Korean elderly. *PLoS ONE*. 2014;**9**(6):e98043.
- **28** Chan DC, Hao YT, Wu SC. Characteristics of outpatient prescriptions for frail Taiwanese elders with long-term care needs. *Pharmacoepidemiology & Drug Safety*. 2009;**18**:327–34.
- **29** Haider SI, Johnell K, Weitoft GR, Thorslund M, Fastbom J. The influence of educational level on polypharmacy and inappropriate drug use: a reg-

- ister-based study of more than 600 000 older people. *Journal of the American Geriatric Society.* 2009;**57**(1):62–9.
- **30** Hiitola PK, Enlund H, Sulkava RO, Hartikainen SA. Changes in the use of cardiovascular medicines in the elderly aged 75 years or older a population-based Kuopio 75+ study. *Journal of Clinical Pharmacy and Therapeutics.*. 2007;**32**(3):253–9.
- **31** Flory JH, Ky B, Haynes K, Brunelli SM, Munson J, Rowan C, et al. Observational cohort study of the safety of digoxin use in women with heart failure. *British Medical Journal Open.* 2012;2:e000888.
- **32** Wastesson JW, Parker MG, Fastbom J, Thorslund M, Johnell K. Drug use in centenarians compared with nonagenarians and octogenarians in Sweden: a nationwide register-based study. *Age and Ageing*. 2012;**41**:218–24.
- 33 Hartikainen S, Rahkonen T, Kautiainen H, Sulkava R. Kuopio 75+ study: does advanced age predict more common use of psychotropics among the elderly? *International Clinical Psychopharmacology*. 2003;18(3):163–7.
- **34** Azermai M, Elseviers M, Petrovic M, Van Bortel L, Vander Stichele R. Geriatric drug utilisation of psychotropics in Belgian nursing homes. *Human Psychopharmacology*. 2011;**26**(1):12–20.
- 35 Skoog J, Midlöv P, Borgquist L, Sundquist J, Halling A. Can gender difference in prescription drug use be explained by gender-related morbidity?: A study on a Swedish population during 2006. *BMC Public Health*. 2014:**14**:329.
- **36** Nobili A, Licata G, Salerno F, Pasina L, Tettamanti M, Franchi C, et al. Polypharmacy, length of hospital stay, and in-hospital mortality among elderly patients in internal medicine wards. The REPOSI study. *European Journal of Clinical Pharmacology*. 2011;**67**(5):507–19.
- **37** Tosato M, Settanni S, Antocicco M, Battaglia M, Corsonello A, Ruggiero C, et al. Pattern of medication use among older inpatients in seven hospitals in Italy: results from the CRiteria to assess Appropriate Medication use among Elderly complex patients (CRIME) project. *Current Drug Safety*. **2013**;**8**(2):98–103.
- **38** Laroche ML, Charmes JP, Nouaille Y, Fourrier A, Merle L. Impact of hospitalisation in an acute medical geriatric unit on potentially inappropriate medication use. *Drugs & Aging*. 2006;**23**(1):49–59.
- **39** Harugeri A, Joseph J, Parthasarathi G, Ramesh M, Guido S. Prescribing patterns and predictors of

- high-level polypharmacy in the elderly population: a prospective surveillance study from two teaching hospitals in India. *American Journal of Geriatric Pharmacotherapy*. 2010;**8**(3):271–80.
- **40** Zuckerman IH, Hernandez JJ, Gruber-Baldini AL, Hebel JR, Stuart B, Zimmerman S, Magaziner J. Potentially inappropriate prescribing before and after nursing home admission among patients with and without dementia. *American Journal of Geriatric Pharmacotherapy*. 2005;**3**(4):246–54.
- **41** Azermai M, Elseviers M, Petrovic M, van Bortel L, Stichele RV. Assessment of antipsychotic prescribing in Belgian nursing homes. *International Psychogeriat- rics.* 2011;**23**(8):1240–8.
- **42** Mann E, Köpke S, Haastert B, Pitkälä K, Meyer G. Psychotropic medication use among nursing home residents in Austria: a cross-sectional study. *BMC Geriatrics*. 2009:**9**:18.
- **43** Kamble P, Chen H, Sherer JT, Aparasu RR. Use of antipsychotics among elderly nursing home residents with dementia in the US: an analysis of National Survey Data. *Drugs & Aging*. 2009;**26**(6):483–92.
- **44** Johnell K, Fastbom J. Comparison of prescription drug use between community-dwelling and institutionalized elderly in Sweden. *Drugs & Aging*. 2012;**29**:751−8.
- **45** Huybrechts KF, Rothman KJ, Brookhart MA, Silliman RA, Crystal S, Gerhard T, Schneeweiss S. Variation in antipsychotic treatment choice across US nursing homes. *Journal of Clinical Psychopharmacology*. 2012;**32**(1):11–17.
- **46** McClean P, Hughes C, Tunney M, Goossens H, Jans B; European Surveillance of Antimicrobial Consumption (ESAC) Nursing Home Project Group. Antimicrobial prescribing in European nursing homes. *Journal of Antimicrobial Chemotherapy*. 2011;**66**(7):1609–16.
- **47** Rikala M, Hartikainen S, Saastamoinen LK, Korhonen MJ. Measuring psychotropic drug exposures in register-based studies validity of a dosage assumption of one unit per day in older Finns. *International Journal of Methods in Psychiatric Research*. 2013;**22**(2):155–65.
- **48** Jansen K, Schaufel MA, Ruths S. Drug treatment at the end of life: an epidemiologic study in nursing homes. *Scandinavian Journal of Primary Health Care*. 2014;**32**(4):187–92.
- **49** Spinewine A, Schmader KE, Barber N, Hughes C, Lapane KL, Swine C, et al. Appropriate prescribing

- in elderly people: how well can it be measured and optimised? *Lancet*. 2007;**370**(9582):173–84.
- **50** O'Mahony D, Gallagher PF. Inappropriate prescribing in the older population: need for new criteria. *Age and Ageing*. 2008;**37**(2):138–41.
- **51** O'Connor MN, Gallagher P, O'Mahony D. Inappropriate prescribing: criteria, detection and prevention. *Drugs & Aging*. 2012;**29**(6):437–52.
- **52** Page RL, 2nd, Linnebur SA, Bryant LL, Ruscin JM. Inappropriate prescribing in the hospitalized elderly patient: defining the problem, evaluation tools, and possible solutions. *Clinical Interventions in Aging*. 2010;**5**:75–87.
- 53 Spinewine A, Fialova D, Byrne S. The role of the pharmacist in optimizing pharmacotherapy in older people. *Drugs & Aging*. 2012;**29**(6):495–510.
- **54** Kaufmann CP, Tremp R, Hersberger KE, Lampert ML. Inappropriate prescribing: a systematic overview of published assessment tools. *European Journal of Clinical Pharmacology*. 2014;**70**(1):1–11.
- 55 Fialova D, Topinkova E, Gambassi G, Finne-Soveri H, Jonsson PV, Carpenter I, et al. Potentially inappropriate medication use among elderly home care patients in Europe. *Journal of the American Medical Association*. 2005;293(11):1348–58.
- **56** Hanlon JT, Schmader KE, Samsa GP, Weinberger M, Uttech KM, Lewis IK, Cohen HJ, Feussner JR. A method for assessing drug therapy appropriateness. *Journal of Clinical Epidemiology*. 1992;**45**(10):1045–51.
- **57** McLeod PJ, Huang AR, Tamblyn RM, Gayton DC. Defining inappropriate practices in prescribing for elderly people: a national consensus panel. *Canadian Medical Agency Journal*. 1997;**156**(3):385–91.
- **58** Jeffery S, Ruby CM, Hanlon JT, Twersky J. Effect of an interdisciplinary team on suboptimal prescribing in a long-term care facility. *Consultant Pharmacy*. 1999;**14**:1386–91.
- **59** Naugler CT, Brymer C, Stolee P, Arcese ZA. Development and validation of an improving prescribing in the elderly tool. *Canadian Journal of Clinical Pharmacology.* 2000;**7**(2):103–7.
- **60** Zhan C, Sangl J, Bierman AS, Miller MR, Friedman B, Wickizer SW, Meyer GS. Potentially inappropriate medication use in the community-dwelling elderly: findings from the 1996 Medical Expenditure Panel Survey. *Journal of the American Medical Association*. 2001;**286**(22):2823–9.

- **61** RAND Health. Quality Indicators ACOVE. Available from: http://www.rand.org/health/projects/acove/acove3.html (last accessed 18 November 2015).
- **62** Beers MH, Ouslander JG, Rollingher I, Reuben DB, Brooks J, Beck JC. Explicit criteria for determining inappropriate medication use in nursing home residents. UCLA Division of Geriatric Medicine. *Archives of Internal Medicine*. 1991;**151**(9):1825–32.
- **63** Beers MH. Explicit criteria for determining potentially inappropriate medication use by the elderly. *Archives of Internal Medicine*.1997;**157**:1531–6.
- **64** Fick DM, Cooper JW, Wade WE, Waller JL, Maclean JR, Beers MH. Updating the Beers criteria for potentially inappropriate medication use in older adults: results of a US consensus panel of experts. *Archives of Internal Medicine*. 2003;**163**(22):2716–24.
- **65** Campanelli CM. American Geriatrics Society Updated Beers Criteria for Potentially Inappropriate Medication Use in Older Adults. *Journal of the American Geriatric Society.* 2012;**60**(4):616–31.
- 66 Rancourt C, Moisan J, Baillargeon L, Verreault R, Laurin D, Gregoire JP. Potentially inappropriate prescriptions for older patients in long-term care. *BMC Geriatrics*. 2004:4:9.
- 67 NCQA. Healthcare Effectiveness Data and Information Set (HEDIS) Criteria 2006 and Update in 2014. Available from: www.ncqa.org (last accessed 18 November 2015).
- **68** Fastbom J, Johnell K. National indicators for quality of drug therapy in older persons: the swedish experience from the first 10 years. *Drugs & Aging*. 2015;**32**(3):189–99.
- **69** Rognstad S, Brekke M, Fetveit A, Spigset O, Wyller TB, Straand J. The Norwegian General Practice (NORGEP) criteria for assessing potentially inappropriate prescriptions to elderly patients. A modified Delphi study. *Scandinavian Journal of Primary Health Care*. 2009;**27**(3):153–9.
- 70 Laroche ML, Charmes JP, Merle L. Potentially inappropriate medications in the elderly: a French consensus panel list. *European Journal of Clinical Pharmacology*. 2007;63(8):725–31.
- 71 Gallagher P, Ryan C, Byrne S, Kennedy J, O'Mahony D. STOPP (Screening Tool of Older Person's Prescriptions) and START (Screening Tool to Alert doctors to Right Treatment). Consensus validation. *International Journal of Clinical Pharmacology and Therapeutics*. 2008;46(2):72–83.

- **72** O'Mahony D, O'Sullivan D, Byrne S, O'Connor MN, Ryan C, Gallagher P. STOPP/START criteria for potentially inappropriate prescribing in older people: version 2. *Age and Ageing*. 2015;**44**(2):213–18.
- **73** Holt S, Schmiedl S, Thurmann PA. Potentially inappropriate medications in the elderly: the PRISCUS list. *Deutsches Ärzteblatt International*. 2010;**107**(31–32):543–51.
- 74 Malik, A. Anant Phadke. Drug supply and use: towards a rational policy in India. *The Free Library*. 22 June 1998. Available from: http://www.the-freelibrary.com/Anant%20Phadke.%20Drug%20 Supply%20and%20Use:%20Towards%20a%20 Rational%20Policy%20in%20India.-a0182200326 (last accessed 18 November 2015).
- 75 National Prescribing Service. Indicators of Quality Prescribing in Australian General Practice. 2006. Available from: http://www.nps.org.au/__data/assets/pdf_file/0019/37351/indicators_full.pdf (last accessed 18 November 2015).
- **76** Basger BJ, Chen TF, Moles RJ. Inappropriate medication use and prescribing indicators in elderly Australians: development of a prescribing indicators tool. *Drugs & Aging*. 2008;**25**(9):777–93.
- 77 Dalleur O, Boland B, Spinewine A. 2012 updated Beers Criteria: greater applicability to Europe? *Journal of the American Geriatric Society*. 2012;60(11):2188–9.
- 78 Ryan C, O'Mahony D, Kennedy J, Weedle P, Barry P, Gallagher P, et al. Appropriate prescribing in the elderly: an investigation of two screening tools, Beers criteria considering diagnosis and independent of diagnosis and improved prescribing in the elderly tool to identify inappropriate use of medicines in the elderly in primary care in Ireland. *Journal of Clinical Pharmacy and Therapeutics*. 2009;34(4):369–76.
- **79** Kumpula EK, Bell JS, Soini H, Pitkälä KH. Anticholinergic drug use and mortality among residents of long-term care facilities: a prospective cohort study. *Journal of Clinical Pharmacology*.2011;**51**:256–63.
- **80** Agar M, Currow D, Plummer J, Seidel R, Carnahan R, Abernethy AP. Changes in anticholinergic load from regular prescribed medications in palliative care as death approaches. *Palliative Medicine*. 2009;**23**:257–65.
- **81** Fox C, Richardson K, Maidment ID, Savva GM, Matthews FE, Smithard D, et al. Anticholinergic medication use and cognitive impairment in the

- older population: the medical research council cognitive function and ageing study. *Journal of the American Geriatric Society.* 2011;**59**:1477–83.
- **82** Hilmer SN, Mager DE, Simonsick EM, Ling SM, Windham BG, Harris TB, et al.; Health ABC Study. Drug burden index score and functional decline in older people. *American Journal of Medicine*. 2009;**122**(12):1142–9, e1–2.
- **83** Tune L, Coyle JT. Serum levels of anticholinergic drugs in treatment of acute extrapyramidal side effects. *Archives of General Psychiatry*. 1980;**37**(3): 293–7.
- **84** Mulsant BH, Pollock BG, Kirshner M, Shen C, Dodge H, Ganguli M. Serum anticholinergic activity in a community-based sample of older adults: relationship with cognitive performance. *Archives of General Psychiatry*. 2003;60:198–203.
- **85** Rudolph JL, Salow MJ, Angelini MC, McGlinchey RE. The anticholinergic risk scale and anticholinergic adverse effects in older persons. *Archives of Internal Medicine*. 2008;168(5):508–13.
- **86** Carnahan RM, Lund BC, Perry PJ, Pollock BG, Culp KR. The Anticholinergic Drug Scale as a measure of drug-related anticholinergic burden: associations with serum anticholinergic activity. *Journal of Clinical Pharmacology*. 2006;**46**(12):1481–6.
- **87** Boustani MA, Campbell NL, Munger S, Maidment I, Fox GC. Impact of anticholinergics on the aging brain: a review and practical application. *Aging Health*. 2008;**4**(3):311–20.
- **88** Campbell N, Boustani M, Limbil T, Ott C, Fox C, Maidment I, et al. The cognitive impact of anticholinergics: a clinical review. *Clinical Interventions in Aging*. 2009;**4**(1):225–33.
- **89** Durán CE, Azermai M, Vander Stichele RH. Systematic review of anticholinergic risk scales in older adults. *European Journal of Clinical Pharmacology*. 2013;**69**(7):1485–96.
- **90** Hilmer SN, Mager DE, Simonsick EM, Cao Y, Ling SM, Windham BG, et al. A drug burden index to define the functional burden of medications in older people. *Archives of Internal Medicine*. 2007;**167**(8):781–7.
- **91** Pont LG, Nielen JT, McLachlan AJ, Gnjidic D, Chan L, Cumming RG, Taxis K. Measuring anticholinergic drug exposure in older community-dwelling Australian men: a comparison of four different measures. Br J Clin Pharmacol. 2015 Nov;80(5):1169–75.

- **92** Kashyap M, Belleville S, Mulsant BH, Hilmer SN, Paquette A, Tu le M, Tannenbaum C. Methodological challenges in determining longitudinal associations between anticholinergic drug use and incident cognitive decline. *Journal of the American Geriatric Society*. 2014;**62**(2):336–41.
- **93** Matanović SM, Vlahovic-Palcevski V. Potentially inappropriate medications in the elderly: a comprehensive protocol. *European Journal of Clinical Pharmacology*. 2012;**68**(8):1123–38.
- 94 Hill-Taylor B, Sketris I, Hayden J, Byrne S, O'Sullivan D, Christie R. Application of the STOPP/START criteria: a systematic review of the prevalence of potentially inappropriate prescribing in older adults, and evidence of clinical, humanistic and economic impact. *Journal of Clinical Pharmacy and Therapeutics*. 2013;38(5):360–72.
- **95** Jano E, Aparasu RR. Healthcare outcomes associated with Beers' Criteria: a systematic review. *Annals of Pharmacotherapy.* 2007;**41**(3):438–47.
- **96** Opondo D, Eslami S, Visscher S, de Rooij SE, Verheij R, Korevaar JC, Abu-Hanna A. Inappropriateness of medication prescriptions to elderly patients in the primary care setting: a systematic review. *PLoS ONE*. 2012;**7**(8):e43617.
- 97 Cherubini A, Corsonello A, Lattanzio F. Underprescription of beneficial medicines in older people: causes, consequences and prevention. *Drugs & Aging*. 2012;**29**(6):463–75.
- **98** Gallagher P, O'Mahony D. STOPP (Screening Tool of Older Persons' potentially inappropriate Prescriptions): application to acutely ill elderly patients and comparison with Beers' Criteria. *Age and Ageing*. 2008;**37**(6):673–9.
- **99** Akazawa M, Imai H, Igarashi A, Tsutani K. Potentially inappropriate medication use in elderly Japanese patients. *American Journal of Geriatric Pharmacotherapy*. 2010;**8**(2):146–60.
- **100** Vik SA, Maxwell CJ, Hogan DB. Measurement, correlates, and health outcomes of medication adherence among seniors. *Annals of Pharmacotherapy*. 2004;**38**(2):303–12.
- **101** Cahir C, Fahey T, Teeling M, Teljeur C, Feely J, Bennett K. Potentially inappropriate prescribing and cost outcomes for older people: a national population study. *British Journal of Clinical Pharmacology*. 2010;**69**(5):543–52.

- **102** Le Couteur D, Banks E, Gnjidic D, McLachlan A. Deprescribing. *Australian Prescriber*. 2011;**34**:182–5.
- 103 Iyer S, Naganathan V, McLachlan AJ, Le Couteur DG. Medication withdrawal trials in people aged 65 years and older: a systematic review. *Drugs & Aging*. 2008;**25**(12):1021–31.
- 104 Ballard C, Lana MM, Theodoulou M, Douglas S, McShane R, Jacoby R, et al.; Investigators DART AD. A randomised, blinded, placebo-controlled trial in dementia patients continuing or stopping neuroleptics (the DART-AD trial). *PLoS Medicine*. 2008;5(4):e76.
- **105** Bergh S, Selbæk G, Engedal K. Discontinuation of antidepressants in people with dementia and neuropsychiatric symptoms (DESEP study): double

- blind, randomised, parallel group, placebo controlled trial. *British Medical Journal*. 2012;**344**:e1566.
- 106 Scott IA, Gray LC, Martin JH, Pillans PI, Mitchell CA. Deciding when to stop: towards evidence-based deprescribing of drugs in older populations. Evidence Based Medicine. 2013;18:121–4.
- 107 Shaffer T, Simoni-Wastila L, Toler W, Stuart B, Doshi JA. Changing patterns in medication use with increasing probability of death for older Medicare beneficiaries. *Journal of the American Geriatric Society*, 2010;58:1549–55.
- **108** Currow DC, Stevensons JP, Abernethy AP, Plummer J, Shelby-James M. Prescribing in palliative care as death approaches. *Journal of the American Geriatric Society.* 2007;**55**:590–5.

- 1 Rosdahl VT, Pedersen KB. The Copenhagen Recommendations. Report from the Invitational EU Conference on the Microbial Threat. Copenhagen, Denmark 9–10 September 1998. Available from: http://soapimg.icecube.snowfall.se/strama/ Kopenhamnsmotet_1998.pdf (last accessed 18 November 2015).
- **2** Howell L, ed. *Global Risks 2013: An Initiative of the Risk Response Network.* Geneva, World Economic Forum, 2013.
- 3 Kaplan W, Laing R. Priority Medicines for Europe and the World 2004. Available from: http://apps. who.int/iris/bitstream/10665/68769/1/WHO_EDM_PAR_2004.7.pdf (last accessed 18 November 2015).
- 4 Kaplan W, Wirtz VJ, Mantel-Teeuwisse A, Stolk P, Duthey B, Laing R. Priority Medicines for Europe and the World 2013 Update. Available from: http://www.who.int/medicines/areas/priority_medicines/MasterDocJune28_FINAL_Web.pdf (last accessed 18 November 2015).
- 5 World Health Organization. Draft Global Action Plan on Antimicrobial Resistance. Available from: http://who.int/drugresistance/en/ (last accessed 18 November 2015).
- 6 Nordic Medico Statistical Committee (NOMESCO). Nordic Statistics on Medicines. Statistical Report of the Nordic Countries 1975–1977. Available from: https://unov.tind.io/record/9196?ln=en (last accessed 18 November 2015).
- 7 Nordic Medico Statistical Committee (NOMESCO). Health Statistics for the Nordic Countries 2013. Available from: http://nowbase.org/~/media/ Projekt%20sites/Nowbase/Publikationer/Helse/ Health%20Statistics%202013.ashx (last accessed 18 November 2015).

- 8 Statens Serum Institut, National Veterinary Institute, National Food Institute. DANMAP Use of Antimicrobial Agents and Occurrence of Antimicrobial Resistance in Bacteria from Food Animals, Food and Humans in Denmark. Available from: http://www.danmap.org/Downloads/~/media/Projekt%20sites/Danmap/DANMAP%20reports/Danmap_2011.ashx (last accessed 18 November 2015).
- 9 The Dutch Working Party on Antibiotic Policy SWAB. Consumption of Antimicrobial Agents and Antimicrobial Resistance among Medically Important Bacteria in The Netherlands. Available from: http://www.rivm.nl/Documenten_en_publicaties/Wetenschappelijk/Rapporten/2015/juni/Nethmap_2015_Consumption_of_antimicrobial_agents_and_antimicrobial_resistance_among_medically_important_bacteria_in_the_Netherlands_Maran_2015_Monitoring_of_antimicrobial_resistance_and_antibiotic_usage_in_animals_in_the_Netherlands_in (last accessed 18 November 2015).
- 10 Public Health Agency of Sweden and National Veterinary Institute. A Report on Swedish Antibiotic Utilisation and Resistance in Human Medicine (SWEDRES) and Swedish Veterinary Antimicrobial Resistance Monitoring (SVARM). Available from: https://www.folkhalsomyndigheten.se/pagefiles/17612/Swedres-Svarm-2013.pdf (last accessed 18 November 2015).
- 11 NORM/NORM-VET. Usage of Antimicrobial agents and Occurrence of Antimicrobial Resistance in Norway. Available from: http://www.vetinst.no/eng/Publications/NORM-NORM-VET-Report (last accessed 18 November 2015).
- 12 Shaban RZ, Cruickshank M, Christiansen K; The Antimicrobial Resistance Standing Committee. National surveillance and reporting of antimicrobial resistance and antibiotic usage for human health in Australia. Available from:

- http://www.safetyandquality.gov.au/publications/national-surveillance-and-reporting-of-antimicrobial-resistance-and-antibiotic-usage-for-human-health-in-australia/ (last accessed 18 November 2015).
- 13 Government of Canada, Public Health Agency of Canada. Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) Human Antimicrobial Use Short Report 2000–2010. Available from: http://www.phac-aspc.gc.ca/cipars-picra/pubs-eng.php (last accessed 18 November 2015).
- 14 Infectious Diseases Society of America. IDSA Press Release STAAR Act. Available from: http://www.idsociety.org/uploadedFiles/IDSA/Policy_and_Advocacy/Current_Topics_and_Issues/Antimicrobial_Resistance/Strengthening_US_Efforts/STAAR_Act/IDSA%20STAAR%20press%20release%20Brown%20reintro%2041014%20FINAL.pdf (last accessed 18 November 2015).
- 15 One Health Initiative website: www.onehealthinitiative.com.
- 16 European Medicines Agency. Trends in the Sales of Veterinary Antimicrobial Agents in Nine European Countries. Available from: http://www.ema.europa.eu/docs/en_GB/document_library/Report/2011/09/WC500112309.pdf (last accessed 18 November 2015).
- 17 Collignon P, Powers JH, Chiller TM, Aidara-Kane A, Aarestrup FM. World Health Organization ranking of antimicrobials according to their importance in human medicine: a critical step for developing risk management strategies for the use of antimicrobials in food production animals. *Clinical Infectious Diseases*. 2009;49(1):132–41.
- **18** Aidara-Kane A, Andremont A, Collignon P. Antimicrobial resistance in the food chain and the AGISAR initiative. *Journal of Infection and Public Health*. 2013;**6**(3):162–5.
- **19** Bronzwaer SL, Cars O, Buchholz U, Molstad S, Goettsch W, Veldhuijzen IK, et al. A European study on the relationship between antimicrobial use and antimicrobial resistance. *Emerging Infectious Diseases*. 2002:**8**(3):278–82.
- **20** Goossens H, Ferech M, Vander Stichele R, Elseviers M. Outpatient antibiotic use in Europe and association with resistance: a cross-national database study. *Lancet.* 2005;**365**(9459):579–87.

- **21** van de Sande-Bruinsma N, Grundmann H, Verloo D, Tiemersma E, Monen J, Goossens H, et al. Antimicrobial drug use and resistance in Europe. *Emerging Infectious Diseases*. 2008;**14**(11):1722–30.
- 22 Schechner V, Temkin E, Harbarth S, Carmeli Y, Schwaber MJ. Epidemiological interpretation of studies examining the effect of antibiotic usage on resistance. *Clinical Microbiology Reviews*. 2013;26(2):289–307.
- **23** Costelloe C, Metcalfe C, Lovering A, Mant D, Hay AD. Effect of antibiotic prescribing in primary care on antimicrobial resistance in individual patients: systematic review and meta-analysis. *British Medical Journal* 2010;**340**:c2096.
- 24 Malhotra-Kumar S, Lammens C, Coenen S, Van Herck K, Goossens H. Effect of azithromycin and clarithromycin therapy on pharyngeal carriage of macrolide-resistant streptococci among healthy volunteers: a randomised, double-blind, placebo-controlled study. *Lancet*. 2007;369:482–90.
- **25** Chung A, Perera R, Brueggemann AB, Elamin AE, Harnden A, Mayon-White R, et al. Effect of antibiotic prescribing on antibiotic resistance in individual children in primary care: prospective cohort study. *British Medical Journal*. 2007;**335**:429.
- **26** Little P, Gould C, Williamson I, Warner G, Gantley M, Kinmonth AL. Reattendance and complications in a randomised trial of prescribing strategies for sore throat: the medicalising effect of prescribing antibiotics [see comments]. *British Medical Journal*. 1997;**315**:350–2.
- **27** Weil-Olivier C, van der Linden M, de Schutter I, Dagan R, Mantovani L. Prevention of pneumococcal diseases in the post-seven valent vaccine era: a European perspective. *BMC Infectious Diseases*. 2012;**12**:207-2334-12-207.
- 28 Adriaenssens N, Coenen S, Versporten A, Muller A, Minalu Ayele G, Faes C, et al. European Surveillance of Antimicrobial Consumption (ESAC): outpatient antibiotic use in Europe (1997–2009). *Journal of Antimicrobial Chemotherapy*. 2011;66(Suppl. 6):vi3–12.
- 29 Adriaenssens N, Coenen S, Versporten A, Muller A, Vankerckhoven V, Goosens H, et al. European Surveillance of Antimicrobial Consumption (ESAC): quality appraisal of outpatient antibiotic use in Europe. *Journal of Antimicrobial Chemotherapy*. 2011;66(Suppl. 6):vi71–7.

- **30** Coenen S, Gielen B, Blommaert A, Beutels P, Hens N, Goossens H. Appropriate international measures for outpatient antibiotic prescribing and consumption: recommendations from a national data comparison of different measures. *Journal of Antimicrobial Chemotherapy*. 2014;**69**:529–34.
- **31** Bruyndonckx R, Hens N, Aerts M, Goossens H, Molenberghs G, Coenen S. Measuring trends of outpatient antibiotic use in Europe: jointly modelling longitudinal data in defined daily doses and packages. *Journal of Antimicrobial Chemotherapy*. 2014;**69**(7):1981–6.
- **32** Van Boeckel TP, Gandra S, Ashok A, Caudron Q, Grenfell BT, Levin SA, et al. Global antibiotic consumption 2000 to 2010: an analysis of national pharmaceutical sales data. *Lancet Infectious Diseases*. 2014;**14**(8):742–50.
- 33 Coenen S, Ferech M, Malhotra-Kumar S, Hendrickx E, Suetens C, Goossens H, et al. European Surveillance of Antimicrobial Consumption (ESAC): outpatient macrolide, lincosamide and streptogramin (MLS) use in Europe. *Journal of Antimicrobial Chemotherapy*. 2006;58:418–22.
- **34** Ferech M, Coenen S, Malhotra-Kumar S, Dvorakova K, Hendrickx E, Suetens C, et al. European Surveillance of Antimicrobial Consumption (ESAC): outpatient quinolone use in Europe. *Journal of Antimicrobial Chemotherapy*. 2006;**58**:423–7.
- 35 Statens Serum Institut, National Veterinary Institute, National Food Institute. DANMAP 2012 Use of Antimicrobial Agents and Occurrence of Antimicrobial Resistance in Bacteria from Food Animals, Food and Humans in Denmark. Available from: http://www.danmap.org/Downloads/~/media/Projekt%20sites/Danmap/DANMAP%20reports/DANMAP%202012/Danmap_2012.ashx(lastaccessed 18 November 2015).
- **36** Coenen S, Ferech M, Haaijer-Ruskamp FM, Butler CC, Vander Stichele RH, Verheij TJM, et al. European Surveillance of Antimicrobial Consumption (ESAC): quality indicators for outpatient antibiotic use in Europe. *Quality & Safety in Health Care*. 2007;**16**(6):440–5.
- 37 Versporten A, Bolokhovets G, Ghazaryan L, Abilova V, Pyshnik G, Spasojevic T, et al. Antibiotic use in eastern Europe: a cross-national database study in coordination with the WHO Regional Office for Europe. *Lancet Infectious Diseases*. 2014;14(5):381–7.

- 38 WHO Regional Office for Europe and Universiteit Antwerpen. Four-fold difference in antibiotic consumption across the European Region new WHO report. Available from: http://www.euro.who.int/en/media-centre/sections/press-releases/2014/four-fold-difference-in-antibiotic-consumption-across-the-european-region-new-who-report (last accessed 18 November 2015).
- **39** Goossens H, Ferech M, Coenen S, Stephens P; European Surveillance of Antimicrobial Consumption Project Group. Comparison of outpatient systemic antibacterial use in 2004 in the United States and 27 European countries. *Clinical Infectious Diseases*. 2007;**44**(8):1091–5.
- **40** Australian Government Department of Health. Australian Statistics on Medicines 2011. Available from: http://www.pbs.gov.au/info/news/2014/04/asm-2011 (last accessed 18 November 2015).
- 41 European Centre for Disease Prevention and Control. Surveillance of Antimicrobial Consumption in Europe 2011. Available from: http://ecdc.europa.eu/en/publications/Publications/antimicrobial-consumption-europe-surveillance-2011.pdf (last accessed.
- **42** Wirtz VJ, Dreser A, Gonzales R. Trends in antibiotic utilization in eight Latin American countries, 1997–2007. *Revista Panamericana de Salud Pública*. 2010;**27**(3):219–25.
- **43** World Health Organization, UNICEF. Building a Future for Women and Children. The 2012 Report. Available from: http://www.unicef.org/eapro/Countdown_to_2015.pdf (last accessed 18 November 2015).
- **44** Grigoryan L, Haaijer-Rysjamp FM, Burgerhof JG, Mechtler R, Deschepper R, Tambic-Andrasevic A, et al. Self-medication with antimicrobial drugs in Europe. *Emerging Infectious Diseases*. 2006;**12**(3):452–9.
- **45** Grigoryan L, Monnet DL, Haaijer-Ruskamp FM, Bonten MJ, Lundborg S, Verheij TJ. Self-medication with antibiotics in Europe: a case for action. *Current Drug Safety*. 2010;**5**(4):329–32.
- **46** Berzanskyte A, Valinteliene R, Haaijer-Ruskamp FM, Gurevicius R, Grigoryan L. Self-medication with antibiotics in Lithuania. *International Journal of Occupational Medicine & Environmental Health*. 2006;**19**(4):246−53.
- **47** Mainous AG 3rd, Cheng AY, Garr RC, Tilley BC, Everett CJ, McKee MD. Nonprescribed antimicrobial

- drugs in Latino community, South Carolina. *Emerging Infectious Diseases*. 2005;**11**(6):883–8.
- **48** Morgan DJ, Okeke IN, Laxminarayan R, Perencevich EN, Weisenberg S. Non-prescription antimicrobial use worldwide: a systematic review. *Lancet Infectious Diseases*. 2011;**11**(9):692–701.
- **49** Santa-Ana-Tellez Y, Mantel-Teeuwisse AK, Dreser A, Leufkens HG, Wirtz VJ. Impact of over-the-counter restrictions on antibiotic consumption in Brazil and Mexico. *PLoS ONE*. 2013;**8**(10):e75550.
- **50** Raz R, Edelstein H, Grigoryan L, Haaijer-Ruskamp FM. Self-medication with antibiotics by a population in northern Israel. *Israeli Medical Association Journal*. 2005;**7**(11):722–5.
- 51 European Centre for Disease Prevention and Control. Surveillance of Antimicrobial Consumption in Europe 2012. Available from: http://ecdc.europa.eu/en/publications/Publications/antimicrobial-consumption-europe-esac-net-2012.pdf (last accessed 06 January 2016).
- **52** Lee GC, Reveles KR, Attridge RT, Lawson KA, Mansi IA, Lewis JS 2nd, et al. Outpatient antibiotic prescribing in the United States: 2000 to 2010. *BMC Medicine*. 2014;**12**:96-7015-12-96.
- 53 Versporten A, Coenen S, Adriaenssens N, Muller A, Minalu G, Faes C, et al. European Surveillance of Antimicrobial Consumption (ESAC): outpatient penicillin use in Europe (1997–2009). Journal of Antimicrobial Chemotherapy. 2011;66(Suppl. 6): vi13–23.
- **54** Versporten A, Coenen S, Adriaenssens N, Muller A, Minalu G, Faes C, et al. European Surveillance of Antimicrobial Consumption (ESAC): outpatient cephalosporin use in Europe (1997–2009). Journal of Antimicrobial Chemotherapy. 2011;**66**(Suppl. 6):vi25–35.
- 55 Adriaenssens N, Coenen S, Versporten A, Muller A, Minalu Ayele G, Faes C, et al. European Surveillance of Antimicrobial Consumption (ESAC): outpatient macrolide, lincosamide and streptogramin use in Europe (1997–2009). Journal of Antimicrobial Chemotherapy. 2011;66(Suppl. 6):vi37–45.
- 56 Adriaenssens N, Coenen S, Versporten A, Muller A, Minalu Ayele G, Faes C, et al. European Surveillance of Antimicrobial Consumption (ESAC): outpatient quinolone use in Europe (1997–2009). Journal of Antimicrobial Chemotherapy. 2011;66(Suppl. 6): vi47–56

- 57 Coenen S, Adriaenssens N, Versporten A, Muller A, Minalu G, Faes C, et al. European Surveillance of Antimicrobial Consumption (ESAC): outpatient use of tetracyclines, sulphonamides and trimethoprim, and other antibacterials in Europe (1997–2009). Journal of Antimicrobial Chemotherapy. 2011;66(Suppl. 6):vi57–70.
- 58 Minalu G, Aerts M, Coenen S, Versporten A, Muller A, Adriaenssens N, et al. Application of mixed-effects models to study the country-specific outpatient antibiotic use in Europe: a tutorial on longitudinal data analysis. Journal of Antimicrobial Chemotherapy. 2011;66 (Suppl. 6):vi79–87.
- 59 National Committee for Quality Assurance. HEDIS 2009 Summary Table of Measures, Product Lines and Changes. Available from: http://www.ncqa.org/Portals/0/HEDISQM/HEDIS2009/2009_Measures.pdf (last accessed 18 November 2015).
- 60 Scottish Medicines Consortium & Scottish Antimicrobial Prescribing Group. Supporting Improvement in Antibiotic Prescribing in Primary Care: Reducing Total Antibiotic Use through a National Quality Indicator. Available from: https://www.scottishmedicines.org.uk/SAPG/Quality_Improvement/Primary_Care (last accessed 18 November 2015).
- 61 Adriaenssens N, Coenen S, Tonkin-Crine S, Verheij TJ, Little P, Goossens H, et al. European Surveillance of Antimicrobial Consumption (ESAC): disease-specific quality indicators for outpatient antibiotic prescribing. *British Medical Journal Quality & Safety*. 2011;20(9):764–72.
- **62** Adriaenssens N, Bartholomeeusen S, Ryckebosch P, Coenen S. Quality of antibiotic prescription during office hours and out-of-hours in Flemish primary care, using European quality indicators. *European Journal of General Practice*. 2014;**20**(2):114–20.
- 63 de Hoog ML, Venekamp RP, van der Ent CK, Schilder A, Sanders EA, Damoiseaux RA, et al. Impact of early daycare on healthcare resource use related to upper respiratory tract infections during childhood: prospective WHISTLER cohort study. BMC Medicine. 2014;12(1):107.
- **64** Keogh C, Motterlini N, Reulbach U, Bennett K, Fahey T. Antibiotic prescribing trends in a paediatric sub-population in Ireland. *Pharmacoepidemiology & Drug Safety.* 2012;**21**(9):945–52.
- **65** Blix HS, Engeland A, Litleskare I, Ronning M. Age- and gender-specific antibacterial prescribing

- in Norway. *Journal of Antimicrobial Chemotherapy*. 2007;**59**(5):971–6.
- Spyridis N, Sharland M. The European Union Antibiotic Awareness Day: the paediatric perspective. *Archives of Disease in Childhood*. 2008;**93**(11):909–10.
- Clavenna A, Bonati M. Differences in antibiotic prescribing in paediatric outpatients. *Archives of Disease in Childhood*. 2011;**96**(6):590–5.
- Matuz M, Benko R, Elseviers M, Hajdu E, Doro P, Viola R, Soos Gy. Dosage form data used for estimating pediatric antibiotic use Scientia Pharmaceutica. 2015;**83**(3):511–8.
- Kaguelidou F, de Bie S, Verhamme K, de Ridder M, Picelli G, Strauš S, et al. New quality indicators for paediatric antibiotic prescribing in primary care: a population based cohort study in the United Kingdom, Italy and the Netherlands from 1995–2010. Archives of Disease in Childhood. 2016;101(1):e1
- Basu S, Chatterjee M, Chandra PK, Basu S. Antibiotic misuse in children by the primary care physicians an Indian experience. *Nigerian Journal of Clinical Practice*. 2008;**11**(1):52–7.
- **71** Friedman BC, Schwabe-Warf D, Goldman R. Reducing inappropriate antibiotic use among children with influenza infection. *Canadian Family Physician*. 2011;**57**(1):42–4.
- Urkin J, Allenbogen M, Friger M, Vinker S, Reuveni H, Elahayani A. Acute pharyngitis: low adherence to guidelines highlights need for greater flexibility in managing paediatric cases. *Acta Paediatrica*. 2013;**102**(11):1075–80.
- Huang YH, Huang YC. Use of antimicrobial agents for upper respiratory tract infections in Taiwanese children. *Chang Gung Medical Journal*. 2005;**28**(11):758–64.
- **74** Gaur AH, Hare ME, Shorr RI. Provider and practice characteristics associated with antibiotic use in children with presumed viral respiratory tract infections. *Pediatrics*. 2005;**115**(3):635–41.
- Eckel N, Sarganas G, Wolf IK, Knopf H. Pharmacoepidemiology of common colds and upper respiratory tract infections in children and adolescents in Germany. *BMC Pharmacology & Toxicology.* 2014;**15**:44-6511-15-44.
- Kenealy T, Arroll B. Antibiotics for the common cold and acute purulent rhinitis. *Cochrane Database of Systematic Reviews*. 2013;**6**:CD000247.

- 77 Keith T, Saxena S, Murray J, Sharland M. Risk-benefit analysis of restricting antimicrobial prescribing in children: what do we really know? *Current Opinions in Infectious Disease*. 2010;**23**(3):242–8.
- Gavazzi G, Krause KH. Ageing and infection. *Lancet Infectious Diseases*. 2002;**2**(11):659–66.
- Yoshikawa TT. Epidemiology and unique aspects of aging and infectious diseases. *Clinical Infectious Diseases*. 2000;**30**(6):931–3.
- Christensen K, Doblhammer G, Rau R, Vaupel JW. Ageing populations: the challenges ahead. *Lancet*. 2009;**374**(9696):1196–208.
- Loeb MB, Craven S, McGeer AJ, Simor AE, Bradley SF, Low DE, et al. Risk factors for resistance to antimicrobial agents among nursing home residents. *American Journal of Epidemiology.* 2003;**157**(1):40–7.
- Blix HS, Roed J, Sti MO. Large variation in antibacterial use among Norwegian nursing homes. *Scandinavian Journal of Infectious Disease*. 2007;**39**(6–7):536–41.
- Loeb M, Simor AE, Landry L, Walter S, McArthur M, Duffy J, et al. Antibiotic use in Ontario facilities that provide chronic care. *Journal of General Internal Medicine*. 2001;**16**(6):376–83.
- McClean P, Hughes C, Tunney M, Goossens H, Jans B, European Surveillance of Antimicrobial Consumption (ESAC) Nursing Home Project Group. Antimicrobial prescribing in European nursing homes. *Journal of Antimicrobial Chemotherapy*. 2011;**66**(7):1609–16.
- **85** Albert X, Huertas I, Pereiro II, Sanfelix J, Gosalbes V, Perrota C. Antibiotics for preventing recurrent urinary tract infection in non-pregnant women. *Cochrane Database of Systematic Reviews*. 2004;**3**(3):CD001209.
- **86** Marwick CA, Yu N, Lockhart MC, McGuigan CC, Wiuff C, Davey PG, et al. Community-associated *Clostridium difficile* infection among older people in Tayside, Scotland, is associated with antibiotic exposure and care home residence: cohort study with nested case-control. *Journal of Antimicrobial Chemotherapy*. 2013;**68**(12):2927–33.
- 87 Scottish Antimicrobial Prescribing Group. Report on Antimicrobial Use and Resistance in Humans in 2012. Available from: http://www.isdscotland.org/Health-Topics/Prescribing-and-Medicines/Publications/2014-01-28/2014-01-28-SAPG-2012-Report. pdf (last accessed 18 November 2015).

- **88** Grol R. Personal paper. Beliefs and evidence in changing clinical practice. *British Medical Journal*. 1997;**315**(7105):418–21.
- **89** Teixeira Rodrigues A, Roque F, Falcao A, Figueiras A, Herdeiro MT. Understanding physician antibiotic prescribing behaviour: a systematic review of qualitative studies. *International Journal of Antimicrobial Agents*. 2013;**41**(3):203–12.
- **90** Almirall J, Bolibar I, Serra-Prat M, Roig J, Hospital I, Carandell E, et al. New evidence of risk factors for community-acquired pneumonia: a population-based study. *European Respiratory Journal*. 2008;**31**(6):1274–84.
- **91** Baik I, Curhan GC, Rimm EB, Bendich A, Willett WC, Fawzi WW. A prospective study of age and lifestyle factors in relation to community-acquired pneumonia in US men and women. *Archives of Internal Medicine*. 2000;**160**(20):3082–8.
- **92** Blix HS, Hjellvik V, Litleskare I, Ronning M, Tverdal A. Cigarette smoking and risk of subsequent use of antibacterials: a follow-up of 365,117 men and women. *Journal of Antimicrobial Chemotherapy*. 2011;**66**(9):2159–67.
- **93** de Roux A, Cavalcanti M, Marcos MA, Garcia E, Ewig S, Mensa J, et al. Impact of alcohol abuse in the etiology and severity of community-acquired pneumonia. *Chest.* 2006;**129**(5):1219–25.
- **94** Falagas ME, Kompoti M. Obesity and infection. *Lancet Infectious Diseases*. 2006;**6**(7):438–46.
- **95** Koivula I, Sten M, Makela PH. Risk factors for pneumonia in the elderly. *American Journal of Medicine*. 1994;**96**(4):313–20.
- **96** Nuorti JP, Butler JC, Farley MM, Harrison LH, McGeer A, Kolczak MS, et al.; Active Bacterial Core Surveillance Team. Cigarette smoking and invasive pneumococcal disease. *New England Journal of Medicine*. 2000;**342**(10):681–9.
- 97 Rogers MA, Greene MT, Saint S, Chenoweth CE, Malani PN, Trivedi I, et al. Higher rates of Clostridium difficile infection among smokers. *PLoS ONE*. 2012;7(7):e42091.
- **98** Hulscher ME, van der Meer JW, Grol RP. Antibiotic use: how to improve it? *International Journal of Medical Microbiology*. 2010;**300**(6):351–6.
- **99** European Commission. Antimicrobial Resistance Report 2013. Available from: http://ec.europa.eu/health/antimicrobial_resistance/docs/ebs_407_en.pdf (last accessed 18 November 2015).

- **100** Mangione-Smith R, McGlynn EA, Elliott MN, Krogstad P, Brook RH. The relationship between perceived parental expectations and pediatrician antimicrobial prescribing behavior. *Pediatrics*. 1999;**103**(4 Pt 1):711–18.
- **101** Deschepper R, Vander Stichele RH, Haaijer-Ruskamp FM. Cross-cultural differences in lay attitudes and utilisation of antibiotics in a Belgian and a Dutch city. *Patient Education & Counselling*. 2002;**48**(2):161−9.
- **102** Arnold SR, Straus SE. Interventions to improve antibiotic prescribing practices in ambulatory care. *Cochrane Database of Systematic Reviews*. 2005;**4**(4):CD003539.
- 103 Earnshaw S, DL M, Duncan B, O'Toole J, Ekdahl K, Goossens H, et al. European Antibiotic Awareness Day, 2008 the first Europe-wide public information campaign on prudent antibiotic use: methods and survey of activities in participating countries. *Eurosurveillance*. 2009;30:1–8.
- **104** Sabuncu E, David J, Bernede-Bauduin C, Pepin S, Leroy M, Boelle PY, et al. Significant reduction of antibiotic use in the community after a nationwide campaign in France, 2002–2007. *PLoS Medicine*. 2009;**6**(6):e1000084.
- 105 Coenen S, Costers M, De Corte S, De Sutter A, Goossens H. The first European Antibiotic Awareness Day after a decade of improving outpatient antibiotic use in Belgium. *Acta Clinica Belgica*. 2008;63(5):296–300.
- **106** Goossens H, Coenen S, Costers M, De Corte S, De Sutter A, Gordts B, et al. Achievements of the Belgian Antibiotic Policy Coordination Committee (BAPCOC). *Eurosurveillance*. 2008;**13**:10–13.
- 107 Huttner B, Goossens H, Verheij T, Harbarth S; the CHAMP Consortium. Characteristics and outcomes of public campaigns aimed at improving the use of antibiotics in outpatients in high-income countries. Lancet Infectious Diseases. 2010;10:17–31.
- **108** Edgar T, Boyd SD, Palame MJ. Sustainability for behaviour change in the fight against antibiotic resistance: a social marketing framework. *Journal of Antimicrobial Chemotherapy*. 2009;**63**(2):230–7.
- 109 Coenen S, Van Royen P, Michiels B, Denekens J. Optimizing antibiotic prescribing for acute cough in general practice: a cluster-randomized controlled trial. *Journal of Antimicrobial Chemotherapy*. 2004;**54**(3):661–72.

- 110 Cals JWL, Butler CC, Hopstaken RM, Hood K, Dinant G. Effect of point of care testing for C reactive protein and training in communication skills on antibiotic use in lower respiratory tract infections: cluster randomised trial. *British Medical Journal*. 2009;338:b1374.
- 111 Francis NA, Butler CC, Hood K, Simpson S, Wood F, Nuttall J. Effect of using an interactive booklet about childhood respiratory tract infections in primary care consultations on reconsulting and antibiotic prescribing: a cluster randomised controlled trial. *British Medical Journal* 2009;339:b2885.
- 112 Little P, Stuart B, Francis N, Douglas E, Tonkin-Crine S, Anthierens S, et al. Effects of internet-based training on antibiotic prescribing rates for acute respiratory-tract infections: a multinational, cluster, randomised, factorial, controlled trial. *Lancet*. 2013;382(9899):1175–82.
- 113 Donner A, Klar N. Design and Analysis of Cluster Randomization Trials in Health Research. London, Arnold. 2000.
- **114** Molstad S, Cars O, Struwe J. Strama a Swedish working model for containment of antibiotic resistance. *Eurosurveillance*. 2008;**13**(46):19041.
- 115 Molstad S, Erntell M, Hanberger H, Melander E, Norman C, Skoog G, et al. Sustained reduction of antibiotic use and low bacterial resistance: 10-year follow-up of the Swedish Strama programme. *Lancet Infectious Diseases*. 2008;8(2):125–32.
- 116 Furst J, Cizman M, Mrak J, Kos D, Campbell S, Coenen S, et al. The influence of a sustained multifaceted approach to improve antibiotic prescribing in Slovenia during the past decade: findings and implications. *Expert Review of Anti-Infective Therapy*. 2015;13(2):279–89.
- **117** Bavestrello L, Cabello A, Casanova D. Impact of regulatory measures in the trends of community consumption of antibiotics in Chile. *Revista Médica de Chile*. 2002;**130**(11):1265–72.
- 118 Australian Government, Department of Health.

 The Pharmaceutical Benefits Scheme (PBS) for
 Oral Ciprofloxacin. Available from: http://www.
 pbs.gov.au/medicine/item/1208N (last accessed 18
 November 2015).
- 119 Park S, Soumerai SB, Adams AS, Finkelstein JA, Jang S, Ross-Degnan D. Antibiotic use following a Korean national policy to prohibit medi-

- cation dispensing by physicians. *Health Policy Plan*. 2005;**20**(5):302–9.
- **120** Vander Stichele RH, Elseviers MM, Ferech M, Blot S, Goossens H; European Surveillance of Antibiotic Consumption (ESAC) Project Group. Hospital consumption of antibiotics in 15 European countries: results of the ESAC Retrospective Data Collection (1997–2002). *Journal of Antimicrobial Chemotherapy*. 2006;**58**(1):159–67.
- 121 European Centre for Disease Prevention and Control. Antimicrobial Consumption Interactive Database (ESAC-Net). Available from: http://www.ecdc.europa.eu/en/healthtopics/antimicrobial_resistance/esac-net-database/Pages/database.aspx (last accessed 18 November 2015).
- **122** WHO Collaborating Centre for Drug Statistics Methodology. ATC/DDD Index 2013. Available from: http://www.whocc.no/atc_ddd_index/ (last accessed 18 November 2015).
- **123** Kuster SP, Ruef C, Bollinger AK, Ledergerber B, Hintermann A, Deplazes C, et al. Correlation between case mix index and antibiotic use in hospitals. *Journal of Antimicrobial Chemotherapy*. 2008;**62**(4):837–42.
- **124** Ibrahim OM, Polk RE. Antimicrobial use metrics and benchmarking to improve stewardship outcomes: methodology, opportunities, and challenges. *Infectious Disease Clinics of North America*. 2014;**28**(2):195–214.
- 125 Ansari F, Molana H, Goossens H, Davey P; ESAC II Hospital Care Study Group. Development of standardized methods for analysis of changes in antibacterial use in hospitals from 18 European countries: the European Surveillance of Antimicrobial Consumption (ESAC) longitudinal survey, 2000–06. *Journal of Antimicrobial Chemotherapy*. 2010;65(12):2685–91.
- **126** Zarb P, Amadeo B, Muller A, Drapier N, Vankerckhoven V, Davey P, et al. Identification of targets for quality improvement in antimicrobial prescribing: the web-based ESAC Point Prevalence Survey 2009. *Journal of Antimicrobial Chemotherapy*. 2011;**66**(2):443–9.
- 127 Zarb P, Amadeo B, Muller A, Drapier N, Vankerck-hoven V, Davey P, et al. Identification of targets for quality improvement in antimicrobial prescribing: the web-based ESAC Point Prevalence Survey 2009. *Journal of Antimicrobial Chemotherapy*. 2011;66(2):443–9.

- **128** Kuster SP, Ruef C, Ledergerber B, Hintermann A, Deplazes C, Neuber L, et al. Quantitative antibiotic use in hospitals: comparison of measurements, literature review, and recommendations for a standard of reporting. *Infection*. 2008;**36**(6):549–59.
- **129** Haug JB, Reikvam A. WHO defined daily doses versus hospital-adjusted defined daily doses: impact on results of antibiotic use surveillance. *Journal of Antimicrobial Chemotherapy*. 2013;**68**(12):2940–7.
- **130** Cizman M, Beovic B. Antibiotic hospital consumption expressed in defined daily doses (DDD)/100 bed-days. *Infection*. 2014;**42**(1):223–4.
- **131** Gagliotti C, Ricchizzi E, Buttazzi R, Tumietto F, Resi D, Moro ML. Hospital statistics for antibiotics: defined versus prescribed daily dose. *Infection*. 2014;**42**(5):869–73.
- **132** Irwin A, Sharland M. Measuring antibiotic prescribing in hospitalised children in resource-poor countries: a systematic review. *Journal of Paediatric and Child Health*. 2013;**49**(3):185–92.
- 133 Porta A, Hsia Y, Doerholt K, Spyridis N, Bielicki J, Menson E, et al. Comparing neonatal and paediatric antibiotic prescribing between hospitals: a new algorithm to help international benchmarking. *Journal of Antimicrobial Chemotherapy*. 2012;67(5):1278–86.
- **134** de With K, Steib-Bauert M, Straach P, Kern WV. Is there significant regional variation in hospital antibiotic consumption in Germany? *Infection*. 2006;**34**(5):274–77.
- **135** Benko R, Matuz M, Doro P, Viola R, Hajdu E, Monnet DL, et al. Hungarian hospital antibiotic consumption at the regional level, 1996–2005. *Infection*. 2009;**37**(2):133–7.
- **136** Blix HS, Hartug S. Hospital usage of antibacterial agents in relation to size and type of hospital and geographical situation. *Pharmacoepidemiology & Drug Safety.* 2005;**14**(9):647–9.
- **137** Amadeo B, Dumartin C, Robinson P, Venier AG, Parneix P, Gachie JP, et al. Easily available adjustment criteria for the comparison of antibiotic consumption in a hospital setting: experience in France. *Clinical Microbiology and Infection*. 2010;**16**(6):735–41.
- **138** MacDougall C, Polk RE. Variability in rates of use of antibacterials among 130 US hospitals and risk-adjustment models for interhospital com-

- parison. *Infection Control and Hospital Epidemiology*. 2008;**29**(3):203–11.
- 139 Muraki Y, Kitamura M, Maeda Y, Kitahara T, Mori T, Ikeue H, et al. Nationwide surveillance of antimicrobial consumption and resistance to Pseudomonas aeruginosa isolates at 203 Japanese hospitals in 2010. *Infection*. 2013;41(2):415–23.
- **140** Zarb P, Goossens H. European Surveillance of Antimicrobial Consumption (ESAC): value of a point-prevalence survey of antimicrobial use across Europe. *Drugs.* 2011;**71**(6):745–55.
- 141 Cooke DM, Salter AJ, Phillips I. The impact of antibiotic policy on prescribing in a London teaching hospital. A one-day prevalence survey as an indicator of antibiotic use. *Journal of Antimicrobial Chemotherapy*. 1983;11(5):447–53.
- **142** Ansari F, Erntell M, Goossens H, Davey P. The European surveillance of antimicrobial consumption (ESAC) point-prevalence survey of antibacterial use in 20 European hospitals in 2006. *Clinical Infectious Diseases*. 2009;**49**(10):1496–504.
- 143 Zarb P, Ansari F, Muller A, Vankerckhoven V, Davey PG, Goossens H. Drug utilization 75% (DU75%) in 17 European hospitals (2000–2005): results from the ESAC-2 Hospital Care Sub Project. *Current Clinical Pharmacology*. 2011;6(1):62–70.
- Bergman U, Popa C, Tomson Y, Wettermark B, Einarson TR, Aberg H, et al. Drug utilization 90% a simple method for assessing the quality of drug prescribing. *European Journal of Clinical Pharmacology*. 1998;54(2):113–18.
- 145 Braykov NP, Morgan DJ, Schweizer ML, Uslan DZ, Kelesidis T, Weisenberg SA, et al. Assessment of empirical antibiotic therapy optimisation in six hospitals: an observational cohort study. *Lancet Infectious Diseases*. 2014;14(12):1220–7.
- 146 Malcolm W, Nathwani D, Davey P, Cromwell T, Patton A, Reilly J, et al. From intermittent antibiotic point prevalence surveys to quality improvement: experience in Scottish hospitals. *Antimicrobial Resistance and Infection Control*. 2013;2(1):3-2994-2-3.
- 147 Schouten JA, Hulscher ME, Kullberg BJ, Cox A, Gyssens IC, van der Meer JW, et al. Understanding variation in quality of antibiotic use for community-acquired pneumonia: effect of patient, professional and hospital factors. *Journal of Antimicrobial Chemotherapy*. 2005;**56**(3):575–82.

- **148** van den Bosch CM, Hulscher ME, Natsch S, Gyssens IC, Prins JM, Geerlings SE, et al. Development of quality indicators for antimicrobial treatment in adults with sepsis. *BMC Infectious Diseases*. 2014:14:345-2334-14-345.
- 149 Thern J, de With K, Strauss R, Steib-Bauert M, Weber N, Kern WV. Selection of hospital antimicrobial prescribing quality indicators: a consensus among German antibiotic stewardship (ABS) networkers. *Infection*. 2014;42(2):351–62.
- 150 National Centre for Biotechnology Information. NCBI Medline Thesaurus. Search term: antibiotic prophylaxis. Available from: http://www.ncbi.nlm.nih.gov/mesh/?term=antibiotic+prophylaxis (last accessed 18 November 2015).
- 151 Deverick JA, Sexton DJ. Antimicrobial prophylaxis for prevention of surgical site infection in adults. *UpToDate*. Available from: http://www.uptodate.com/contents/antimicrobial-prophylaxis-for-prevention-of-surgical-site-infection-in-adults (last accessed 18 November 2015).
- **152** Uckay I, Harbarth S, Peter R, Lew D, Hoffmeyer P, Pittet D. Preventing surgical site infections. *Expert Review of Anti-Infective Therapy*. 2010;**8**(6):657–70.
- 153 National Collaborating Centre for Women's and Children's Health (UK). Surgical Site Infection: Prevention and Treatment of Surgical Site Infection. London, RCOG Press, 2008.
- 154 Scottish Intercollegiate Guidelines Network. Antibiotic Prophylaxis in Surgery: A National Clinical Guideline. Available from: http://www.sign.ac.uk/ pdf/sign104.pdf (last accessed 18 November 2015).
- 155 European Centre for Disease Prevention and Control. Surveillance Report. Point Prevalence Survey of Healthcare-Associated Infections and Antimicrobial Use in European Acute Care Hospitals 2011–2012. Available from: http://ecdc.europa.eu/en/publications/Publications/healthcare-associated-infections-antimicrobial-use-PPS.pdf (last accessed 18 November 2015).
- **156** Hohmann C, Eickhoff C, Radziwill R, Schulz M. Adherence to guidelines for antibiotic prophylaxis in surgery patients in German hospitals: a multicentre evaluation involving pharmacy interns. *Infection.* 2012;**40**(2):131–7.
- **157** Durando P, Bassetti M, Orengo G, Crimi P, Battistini A, Bellina D, et al. Adherence to international and national recommendations for the preven-

- tion of surgical site infections in Italy: results from an observational prospective study in elective surgery. *American Journal of Infection Control*. 2012;**40**(10):969–72.
- **158** Napolitano F, Izzo MT, Di Giuseppe G, Angelillo IF; Collaborative Working Group. Evaluation of the appropriate perioperative antibiotic prophylaxis in Italy. *PLoS ONE*. 2013;**8**(11):e79532.
- Miliani K, L'Heriteau F, Astagneau P, INCISO Network Study Group. Non-compliance with recommendations for the practice of antibiotic prophylaxis and risk of surgical site infection: results of a multilevel analysis from the INCISO Surveillance Network. *Journal of Antimicrobial Chemotherapy*. 2009;64(6):1307–15.
- 160 Parulekar L, Soman R, Singhal T, Rodrigues C, Dastur FD, Mehta A. How good is compliance with surgical antibiotic prophylaxis guidelines in a tertiary care private hospital in India? A prospective study. *Indian Journal of Surgery*. 2009;71(1):15–18.
- **161** De Chiara S, Chiumello D, Nicolini R, Vigorelli M, Cesana B, Bottino N, et al. Prolongation of antibiotic prophylaxis after clean and clean-contaminated surgery and surgical site infection. *Minerva Anestesiologica*. 2010;**76**(6):413–19.
- **162** Harbarth S, Samore MH, Lichtenberg D, Carmeli Y. Prolonged antibiotic prophylaxis after cardiovascular surgery and its effect on surgical site infections and antimicrobial resistance. *Circulation*. 2000;**101**(25):2916–21.
- 163 Vincent JL, Rello J, Marshall J, Silva E, Anzueto A, Martin CD, et al. International study of the prevalence and outcomes of infection in intensive care units. *Journal of the American Medical Association*. 2009;302(21):2323–9.
- 164 Maki DG, Tsigrelis C. Nosocomial infection in the intensive care unit. In: Parrillo JE, ed. *Critical Care Medicine: Principles of Diagnosis and Management in the Adult*, 4th edn. Philadelphia, PA, Saunders, 2014.
- 165 Lipman J. Principles of antibiotic use. In: Bersten AD, Soni N. *Oh's Intensive Care Manual*, 7th edn. Oxford, Butterworth-Heinemann, 2014.
- **166** Hanberger H, Arman D, Gill H, Jindrak V, Kalenic S, Kurcz A, et al. Surveillance of microbial resistance in European Intensive Care Units: a first report from the Care-ICU programme for

- improved infection control. *Intensive Care Medicine*. 2009;**35**(1):91–100.
- 167 MacKenzie FM, Monnet DL, Gould IM; ARPAC Steering Group. Relationship between the number of different antibiotics used and the total use of antibiotics in European hospitals. *Journal of Antimicrobial Chemotherapy*, 2006;58(3):657–60.
- **168** Bonhoeffer S, Lipsitch M, Levin BR. Evaluating treatment protocols to prevent antibiotic resistance. *Proceedings of the National Academies of Science USA*. 1997;**94**(22):12 106–11.
- 169 Bonten MJ, Austin DJ, Lipsitch M. Understanding the spread of antibiotic resistant pathogens in hospitals: mathematical models as tools for control. *Clinical Infectious Diseases*. 2001;33(10):1739–46.
- 170 Sandiumenge A, Diaz E, Rodriguez A, Vidaur L, Canadell L, Olona M, et al. Impact of diversity of antibiotic use on the development of antimicrobial resistance. *Journal of Antimicrobial Chemotherapy*. 2006;57(6):1197–204.
- **171** Benko R, Matuz M, Peto Z, Bogar L, Viola R, Doro P, et al. Variations and determinants of antibiotic consumption in Hungarian adult intensive care units. *Pharmacoepidemiology & Drug Safety*. 2012;**21**(1):104–9.
- **172** Liem TB, Krediet TG, Fleer A, Egberts TC, Rademaker CM. Variation in antibiotic use in neonatal intensive care units in the Netherlands. *Journal of Antimicrobial Chemotherapy*, 2010;**65**(6):1270–5.
- 173 Stocker M, Ferrao E, Banya W, Cheong J, Macrae D, Furck A. Antibiotic surveillance on a paediatric intensive care unit: easy attainable strategy at low costs and resources. *BMC Pediatrics*. 2012;12:196-2431-12-196.
- 174 Bassetti M, De Gaudio R, Mazzei T, Morace G, Petrosillo N, Viale P, et al. A survey on infection management practices in Italian ICUs. *Critical Care*. 2012;16(6):R221.
- 175 Erlandsson M, Burman LG, Cars O, Gill H, Nilsson LE, Walther SM, et al. Prescription of antibiotic agents in Swedish intensive care units is empiric and precise. *Scandinavian Journal of Infectious Disease*. 2007;39(1):63–9.
- **176** Hulscher ME, Grol RP, van der Meer JW. Antibiotic prescribing in hospitals: a social and behavioural scientific approach. *Lancet Infectious Diseases*. 2010;**10**(3):167–75.

- **177** Borg MA. Prolonged perioperative surgical prophylaxis within European hospitals: an exercise in uncertainty avoidance? *Journal of Antimicrobial Chemotherapy.* 2014;**69**(4):1142–4.
- 178 Charani E, Castro-Sanchez E, Sevdalis N, Kyratsis Y, Drumright L, Shah N, et al. Understanding the determinants of antimicrobial prescribing within hospitals: the role of 'prescribing etiquette'. *Clinical Infectious Diseases*. 2013;57(2):188–96.
- 179 Dellit TH, Owens RC, McGowan JE Jr, Gerding DN, Weinstein RA, Burke JP, et al. Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America guidelines for developing an institutional program to enhance antimicrobial stewardship. Clinical Infectious Diseases. 2007;44(2):159–77.
- **180** Fishman N. Antimicrobial stewardship. *American Journal of Infection Control*. 2006;**34**(5 Suppl. 1):\$55–63; disc. \$64–73.
- **181** Hamilton KW, Fishman NO. Antimicrobial stewardship interventions: thinking inside and outside the box. *Infectious Disease Clinics of North America*. 2014;**28**(2):301–13.
- **182** Charani E, Castro-Sanchez E, Holmes A. The role of behavior change in antimicrobial stewardship. *Infectious Disease Clinics of North America*. 2014;**28**(2):169–75.
- 183 van Buul LW, Sikkens JJ, van Agtmael MA, Kramer MH, van der Steen JT, Hertogh CM. Participatory action research in antimicrobial stewardship: a novel approach to improving antimicrobial prescribing in hospitals and long-term care facilities. *Journal of Antimicrobial Chemotherapy*. 2014;69(7):1734–41.
- **184** Imai-Kamata S, Fushimi K. Factors associated with adherence to prophylactic antibiotic therapy for elective general surgeries in Japan. *International Journal of Quality Health Care*. 2011;**23**(2):167–72.
- **185** Tourmousoglou CE, Yiannakopoulou EC, Kalapothaki V, Bramis J, St Papadopoulos J. Adherence to guidelines for antibiotic prophylaxis in general surgery: a critical appraisal. *Journal of Antimicrobial Chemotherapy*. 2008;**61**(1):214–18.
- **186** Schmitt C, Lacerda RA, Padoveze MC, Turrini RN. Applying validated quality indicators to surgical antibiotic prophylaxis in a Brazilian hospital: learning what should be learned. *American Journal of Infection Control.* **2012**;**40**(10):960–2.

- **187** Young B, Ng TM, Teng C, Ang B, Tai HY, Lye DC. Nonconcordance with surgical site infection prevention guidelines and rates of surgical site infections for general surgical, neurological, and orthopedic procedures. *Antimicrobial Agents and Chemotherapy*. 2011;**55**(10):4659–63.
- 188 Mahdaviazad H, Masoompour SM, Askarian M. Iranian surgeons' compliance with the American Society of Health-System Pharmacists guidelines: antibiotic prophylaxis in private versus teaching hospitals in Shiraz, Iran. *Journal of Infection and Public Health*. 2011;4(5–6):253–9.
- **189** Hawkins RB, Levy SM, Senter CE, Zhao JY, Doody K, Kao LS, et al. Beyond surgical care improvement program compliance: antibiotic prophylaxis implementation gaps. *American Journal of Surgery*. 2013;**206**(4):451–6.
- **190** van Kasteren ME, Kullberg BJ, de Boer AS, Mintjes-de Groot J, Gyssens IC. Adherence to local hospital guidelines for surgical antimicrobial prophylaxis: a multicentre audit in Dutch hospitals. *Journal of Antimicrobial Chemotherapy*. 2003;**51**(6):1389–96.

- 1 Murray CJ, Vos T, Lozano R, Naghavi M, Flaxman AD, Michaud C, et al. Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet*. 2012:380:2197–223.
- **2** Lim SS, Vos T, Flaxman AD, Danaei G, Shibuya K, ir-Rohani H, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet.* 2012;**380**:2224–60.
- 3 Perk J, De BG, Gohlke H, Graham I, Reiner Z, Verschuren M, et al. European Guidelines on cardiovascular disease prevention in clinical practice (version 2012). The Fifth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of nine societies and by invited experts). European Heart Journal. 2012;33:1635–701.
- **4** Halvorsen S, Andreotti F, ten Berg JM, Cattaneo M, Coccheri S, Marchioli R, et al. Aspirin therapy in primary cardiovascular disease prevention: a position paper of the European Society of Cardiology working group on thrombosis. *Journal of the American College of Cardiology*. 2014;**64**:319–27.
- **5** Morris PB, Ballantyne CM, Birtcher KK, Dunn SP, Urbina EM. Review of clinical practice guidelines for the management of LDL-related risk, *Journal of the American College of Cardiology*. 2014;**64**:196–206.
- **6** Kotseva K, Wood D, De BG, De BD, Pyorala K, Keil U. Cardiovascular prevention guidelines in daily practice: a comparison of EUROASPIRE I, II, and III surveys in eight European countries. *Lancet*. 2009;**373**:929–40.

- **7** Republic of Estonia Agency of Medicine. Estonian Statistics on Medicines 2006–2010. Available from: http://www.ravimiamet.ee/en/statistics-medicines (last accessed 18 November 2015).
- **8** Sakshaug S, Strom H, Berg C, Blix HS, Litleskare I, Granum T. Drug Consumption in Norway 2008–2012. Available from: http://www.fhi.no/dokumenter/5cf2f40d01.pdf (last accessed 18 November 2015).
- **9** Finnish Medicines Agency Fimea and Social Insurance Institution. Finnish Statistics on Medicines. Available from: http://www.kela.fi/web/en/medicine-reimbursement-statistics_finnish-statistics-on-medicines (last accessed 18 November 2015).
- 10 Kildemoes HW, Stovring H, Andersen M. Driving forces behind increasing cardiovascular drug utilization: a dynamic pharmacoepidemiological model. *British Journal of Clinical Pharmacology*. 2008;66: 885–95.
- **11** Jackevicius CA, Cox JL, Carreon D, Tu JV, Rinfret S, So D, et al. Long-term trends in use of and expenditures for cardiovascular medications in Canada. *CMAJ.* 2009;**181**:E19–28.
- 12 Senes S, Penm E. Medicines for cardiovascular health: are they used appropriately? Available from: http://www.aihw.gov.au/WorkArea/Download Asset.aspx?id=6442454974 (last accessed 18 November 2015).
- **13** Wallach KH, Vass M, Hendriksen C, Andersen M. Statin utilization according to indication and age: a Danish cohort study on changing prescribing and purchasing behaviour. *Health Policy*. 2012;**108**:216–27.
- 14 Chow CK, Teo KK, Rangarajan S, Islam S, Gupta R, Avezum A, et al. Prevalence, awareness, treatment, and control of hypertension in rural and urban communities in high-, middle-, and low-income countries. *Journal of the American Medical Association*. 2013;310:959–68.

- **15** Stolk P, Van Wijk BL, Leufkens HG, Heerdink ER. Between-country variation in the utilization of antihypertensive agents: guidelines and clinical practice. *Journal of Human Hypertension*. 2006;**20**:917–22.
- 16 Qvarnstrom M, Kahan T, Kieler H, Brandt L, Hasselstrom J, Bengtsson BK, et al. Persistence to antihypertensive drug treatment in Swedish primary healthcare. European Journal of Clinical Pharmacology. 2013;69:1955–64.
- 17 Tuppin P, Ricci-Renaud P, de Peretti C, Fagot-Campagna A, Gastaldi-Menager C, Danchin N, et al. Antihypertensive, antidiabetic and lipid-lowering treatment frequencies in France in 2010. Archives of Cardiovascular Disease. 2013;106:274–86.
- **18** Wolf M, Heuten HG, De Swaef A, de Falleur M, Verpooten GA. The evolution of hypertension treatment in Belgium, a pharmacoepidemiological study. *Acta Cardiology*. 2012;**67**:147–52.
- **19** Liberman JN, Berger JE, Lewis M. Prevalence of antihypertensive, antidiabetic, and dyslipidemic prescription medication use among children and adolescents. *Archives of Pediatric and Adolescent Medicine*. 2009;**163**:357–64.
- **20** Martirosyan L, Arah OA, Haaijer-Ruskamp FM, Braspenning J, Denig P. Methods to identify the target population: implications for prescribing quality indicators. *BMC Health Services Research*. 2010;**10**:137.
- **21** Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL Jr, et al. The seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure: the JNC 7 report. *Journal of the American Medical Association*. 2003;**289**:2560–72.
- **22** Catic T, Begovic B. Outpatient antihypertensive drug utilization in Canton Sarajevo during five years period (2004-2008) and adherence to treatment guidelines assessment. *Bosnian Journal of Basic Medical Science*. 2011;**11**:97–102.
- **23** Poluzzi E, Strahinja P, Vargiu A, Chiabrando G, Silvani MC, Motola D, et al. Initial treatment of hypertension and adherence to therapy in general practice in Italy. *European Journal of Clinical Pharmacology*. 2005;**61**:603–9.
- **24** Selmer R, Blix HS, Landmark K, Reikvam A. Choice of initial antihypertensive drugs and persistence of drug use a 4-year follow-up of 78 453 incident users. *European Journal of Clinical Pharmacology*. 2012;**68**:1435–42.

- **25** Sofat R, Casas JP, Grosso AM, Prichard BN, Smeeth L, MacAllister R, Hingorani AD. Could NICE guidance on the choice of blood pressure lowering drugs be simplified? *British Medical Journal*. 2012;**344**:d8078.
- **26** Cifkova R, Erdine S, Fagard R, Farsang C, Heagerty AM, Kiowski W, et al. Practice guidelines for primary care physicians: 2003 ESH/ESC hypertension guidelines. *Journal of Hypertension*. 2003;**21**:1779–86.
- **27** Wettermark B, Godman B, Neovius M, Hedberg N, Mellgren TO, Kahan T. Initial effects of a reimbursement restriction to improve the cost-effectiveness of antihypertensive treatment. *Health Policy.* 2010;**94**:221–9.
- **28** Qvarnstrom M, Wettermark B, Ljungman C, Zarrinkoub R, Hasselstrom J, Manhem K, et al. Antihypertensive treatment and control in a large primary care population of 21 167 patients. *Journal of Human Hypertension*. 2011;**25**:484–91.
- **29** Van Wijk BL, Shrank WH, Klungel OH, Schneeweiss S, Brookhart MA, Avorn J. A cross-national study of the persistence of antihypertensive medication use in the elderly, *Journal of Hypertension*. 2008;**26**:145–53.
- **30** Poluzzi E, Strahinja P, Vaccheri A, Vargiu A, Silvani MC, Motola D, et al. Adherence to chronic cardiovascular therapies: persistence over the years and dose coverage. *British Journal of Clinical Pharmacology*. 2007;**63**:346–55.
- 31 Magrini N, Einarson T, Vaccheri A, McManus P, Montanaro N, Bergman U. Use of lipid-lowering drugs from 1990 to 1994: an international comparison among Australia, Finland, Italy (Emilia Romagna Region), Norway and Sweden. *European Journal of Clinical Pharmacology*. 1997;53:185–9.
- **32** Cooke C, Nissen L, Sketris I, Tett SE. Quantifying the use of the statin antilipemic drugs: comparisons and contrasts between Nova Scotia, Canada, and Queensland, Australia. *Clinical Therapeutics*. 2005;**27**:497–508.
- **33** Walley T, Folino-Gallo P, Stephens P, Van Ganse E. Trends in prescribing and utilization of statins and other lipid lowering drugs across Europe 1997–2003. *British Journal of Clinical Pharmacology*. 2005;**60**:543–51.
- **34** Godman B, Sakshaug S, Berg C, Wettermark B, Haycox A. Combination of prescribing restrictions and policies to engineer low prices to reduce reimbursement costs. *Expert Reviews in Pharmacoeconomic Outcomes Research*. 2011;**11**:121–9.

- 35 Vancheri F, Wettermark B, Strender LE, Backlund GE. Trends in coronary heart disease mortality and statin utilization in two European areas with different population risk levels: Stockholm and Sicily. *International Cardiovascular Forum Journal*. 2014;1(3):140–6.
- **36** Lesen E, Sandstrom TZ, Carlsten A, Jonsson AK, Mardby AC, Sundell KA. A comparison of two methods for estimating refill adherence to statins in Sweden: the RARE project. *Pharmacoepidemiology & Drug Safety.* 2011;**20**:1073–9.
- 37 Patented Medicine Prices Review Board. Use of the World Health Organization Defined Daily Dose in Canadian Drug Utilization and Cost Analyses. Available from: http://www.pmprb-cepmb.gc.ca/CMFiles/Publications/Analytical%20Studies/NPDUIS-WHO-DDD-e.pdf (last accessed 18 November 2015).
- 38 Hartz I, Sakshaug S, Furu K, Engeland A, Eggen AE, Njolstad I, Skurtveit S. Aspects of statin prescribing in Norwegian counties with high, average and low statin consumption – an individual-level prescription database study. BMC Clinical Pharmacology. 2007:7:14.
- **39** Jackevicius CA, Tu JV, Ross JS, Ko DT, Carreon D, Krumholz HM. Use of fibrates in the United States and Canada. *Journal of the American Medical Association*. 2011;**305**:1217–24.
- **40** Lu L, Krumholz HM, Tu JV, Ross JS, Ko DT, Jackevicius CA. Impact of the ENHANCE trial on the use of ezetimibe in the United States and Canada. *American Heart Journal*. 2014:**167**:683–9.
- **41** Blazing MA, Giugliano RP, Cannon CP, Musliner TA, Tershakovec AM, White JA, et al. Evaluating cardiovascular event reduction with ezetimibe as an adjunct to simvastatin in 18 144 patients after acute coronary syndromes: final baseline characteristics of the IMPROVE-IT study population. *American Heart Journal*. 2014;**168**:205–12.
- **42** Kuklina EV, Carroll MD, Shaw KM, Hirsch R. Trends in high LDL cholesterol, cholesterol-lowering medication use, and dietary saturated-fat intake: United States, 1976–2010. *NCHS Data Brief*. 2013:**117**:1–8.
- **43** Rikala M, Huupponen R, Helin-Salmivaara A, Korhonen MJ. Channelling of statin use towards low-risk population and patients with diabetes. *Basic Clinical Pharmacology & Toxicology*. 2013;**113**:173–8.

- **44** Shalev V, Weil C, Raz R, Goldshtein I, Weitzman D, Chodick G. Trends in statin therapy initiation during the period 2000–2010 in Israel. *European Journal of Clinical Pharmacology*. 2014;**70**:557–64.
- **45** Jackevicius CA, Tu K, Filate WA, Brien SE, Tu JV. Trends in cardiovascular drug utilization and drug expenditures in Canada between 1996 and 2001. *Canadian Journal of Cardiology.* 2003;**19**:1359–66.
- **46** Teeling M, Bennett K, Feely J. The influence of guidelines on the use of statins: analysis of prescribing trends 1998–2002. *British Journal of Clinical Pharmacology*. 2005;**59**:227–32.
- **47** Martikainen JE, Saastamoinen LK, Korhonen MJ, Enlund H, Helin-Salmivaara A. Impact of restricted reimbursement on the use of statins in Finland: a register-based study. *Medical Care*. 2010;**48**:761–6.
- **48** Martirosyan L, Voorham J, Haaijer-Ruskamp FM, Braspenning J, Wolffenbuttel BH, Denig P. A systematic literature review: prescribing indicators related to type 2 diabetes mellitus and cardiovascular risk management. *Pharmacoepidemiology & Drug Safety.* 2010;**19**:319–34.
- **49** Carey IM, DeWilde S, Shah SM, Harris T, Whincup PH, Cook DG. Statin use after first myocardial infarction in UK men and women from 1997 to 2006: who started and who continued treatment? *Nutrition, Metabolism and Cardiovascular Disease*. 2012;**22**:400–8.
- 50 Kale MS, Bishop TF, Federman AD, Keyhani S. Trends in the overuse of ambulatory health care services in the United States. *Journal of the American Medical Association Internal Medicine*. 2013;173:142–8.
- 51 Javed U, Deedwania PC, Bhatt DL, Cannon CP, Dai D, Hernandez A, et al. Use of intensive lipid-lowering therapy in patients hospitalized with acute coronary syndrome: an analysis of 65 396 hospitalizations from 344 hospitals participating in Get With The Guidelines (GWTG). *American Heart Journal*. 2011;161:418–24.
- **52** van Staa TP, Smeeth L, Ng ES, Goldacre B, Gulliford M. The efficiency of cardiovascular risk assessment: do the right patients get statin treatment? *Heart*. 2013;**99**:1597–602.
- 53 Wu J, Zhu S, Yao GL, Mohammed MA, Marshall T. Patient factors influencing the prescribing of lipid lowering drugs for primary prevention of cardiovascular disease in UK general practice: a national retrospective cohort study. *PLoS ONE*. 2013;8:e67611.

- **54** Kirley K, Qato DM, Kornfield R, Stafford RS, Alexander GC. National trends in oral anticoagulant use in the United States, 2007 to 2011. *Circulation and Cardiovascular Quality Outcomes*. 2012;**5**:615–21.
- 55 Virjo I, Makela K, Aho J, Kalliola P, Kurunmaki H, Uusitalo L, et al. Who receives anticoagulant treatment with warfarin and why? A population-based study in Finland. *Scandinavian Journal of Primary Health Care*. 2010;28:237–41.
- 56 Camm AJ, Kirchhof P, Lip GY, Schotten U, Savelieva I, Ernst S, et al. Guidelines for the management of atrial fibrillation: the Task Force for the Management of Atrial Fibrillation of the European Society of Cardiology (ESC). European Heart Journal. 2010;31(19):2369–429.
- 57 Fuster V, Rydén LE, Cannom DS, Crijns HJ, Curtis AB, Ellenbogen KA, et al. ACC/AHA/ESC 2006 guidelines for the management of patients with atrial fibrillation. *Circulation*. 2006;114(7):e257–354.
- **58** Pottegård A, Poulsen BK, Larsen MD, Hallas J. Dynamics of vitamin K antagonist and new oral anticoagulants use in atrial fibrillation: a Danish drug utilization study. *Journal of Thrombosis and Haemostasis*. 2014;**12**:1413–18.
- **59** Budnitz DS, Lovegrove MC, Shehab N, Richards CL. Emergency hospitalizations for adverse drug events in older Americans. *New England Journal of Medicine*. 2011;**365**:2002–12.
- **60** Xu Y, Holbrook AM, Simpson CS, Dowlatshahi D, Johnson AP. Prescribing patterns of novel oral anti-coagulants following regulatory approval for atrial fibrillation in Ontario, Canada: a population-based descriptive analysis. *CMAJ Open.* 2013;**1**:E115–19.
- 61 Camm AJ, Lip GY, De CR, Savelieva I, Atar D, Hohnloser SH, et al. 2012 focused update of the ESC Guidelines for the management of atrial fibrillation: an update of the 2010 ESC Guidelines for the management of atrial fibrillation developed with the special contribution of the European Heart Rhythm Association. *European Heart Journal*. 2012;33(21):2719–47.
- **62** Godman B, Malmstrom RE, Diogene E, Jayathissa S, McTaggart S, Cars T, et al. Dabigatran a continuing exemplar case history demonstrating the need for comprehensive models to optimize the utilization of new drugs. *Frontiers in Pharmacology.* 2014;**5**:109.
- **63** Olesen JB, Sorensen R, Hansen ML, Lamberts M, Weeke P, Mikkelsen AP, et al. Non-vitamin K antag-

- onist oral anticoagulation agents in anticoagulant naive atrial fibrillation patients: Danish nationwide descriptive data 2011–2013. *Europace*. 2015;17: 187–93.
- **64** Ogilvie IM, Newton N, Welner SA, Cowell W, Lip GY. Underuse of oral anticoagulants in atrial fibrillation: a systematic review. *American Journal of Medicine*. 2010;**123**:638–45.
- **65** Mohammed MA, Marshall T, Nirantharakumar K, Stevens A, Fitzmaurice D. Patterns of warfarin use in subgroups of patients with atrial fibrillation: a cross-sectional analysis of 430 general practices in the United Kingdom. *PLoS ONE*. 2013;**8**:e61979.
- 66 Forslund T, Wettermark B, Wandell P, von Euler M, Hasselstrom J, Hjemdahl P. Risk scoring and throm-boprophylactic treatment of patients with atrial fibrillation with and without access to primary healthcare data: experience from the Stockholm health care system. *International Journal of Cardiology*. 2013;170:208–14.
- 67 Forslund T, Wettermark B, Wandell P, von Euler M, Hasselstrom J, Hjemdahl P. Risks for stroke and bleeding with warfarin or aspirin treatment in patients with atrial fibrillation at different CHA(2) DS(2)VASc scores: experience from the Stockholm region. *European Journal of Clinical Pharmacology*. 2014;70:1477–85.
- **68** Baczek VL, Chen WT, Kluger J, Coleman CI. Predictors of warfarin use in atrial fibrillation in the United States: a systematic review and meta-analysis. *BMC Family Practice*. 2012;**13**:5.
- **69** Desai NR, Krumme AA, Schneeweiss S, Shrank WH, Brill G, Pezalla EJ, et al. Patterns of initiation of oral anticoagulants in patients with atrial fibrillation quality and cost implications. *American Journal of Medicine*. 2014:**127**:1075–82.
- 70 Pfeilschifter W, Luger S, Brunkhorst R, Lindhoff-Last E, Foerch C. The gap between trial data and clinical practice an analysis of case reports on bleeding complications occurring under dabigatran and rivaroxaban anticoagulation. *Cerebrovascular Disease*. 2013;36:115–19.
- 71 Schmidt M, Hallas J, Friis S. Potential of prescription registries to capture individual-level use of aspirin and other nonsteroidal anti-inflammatory drugs in Denmark: trends in utilization 1999–2012. *Clinical Epidemiology*. 2014;6:155–68.

- **72** Yusuf S, Islam S, Chow CK, Rangarajan S, Dagenais G, Diaz R, et al. Use of secondary prevention drugs for cardiovascular disease in the community in high-income, middle-income, and low-income countries (the PURE Study): a prospective epidemiological survey. *Lancet*. 2011;**378**:1231–43.
- **73** VanWormer JJ, Miller AW, Rezkalla SH. Aspirin overutilization for the primary prevention of cardiovascular disease. *Clinical Epidemiology*. 2014:**6**:433–40.
- **74** Cramer JA, Benedict A, Muszbek N, Keskinaslan A, Khan ZM. The significance of compliance and persistence in the treatment of diabetes, hypertension and dyslipidaemia: a review. *International Journal of Clinical Practice*. 2008;**62**:76–87.
- **75** Chowdhury R, Khan H, Heydon E, Shroufi A, Fahimi S, Moore C, et al. Adherence to cardiovascular therapy: a meta-analysis of prevalence and clinical consequences. *European Heart Journal*. 2013;**34**:2940–8.
- **76** Lemstra M, Blackburn D, Crawley A, Fung R. Proportion and risk indicators of nonadherence to statin therapy: a meta-analysis. *Canadian Journal of Cardiology*. 2012;**28**:574–80.
- 77 Lewey J, Shrank WH, Bowry AD, Kilabuk E, Brennan TA, Choudhry NK. Gender and racial disparities in adherence to statin therapy: a meta-analysis. *American Heart Journal*. 2013;**165**:665–78.
- **78** Kneeland PP, Fang MC. Current issues in patient adherence and persistence: focus on anticoagulants for the treatment and prevention of thromboembolism. *Patient Preference and Adherence*. 2010;**4**:51–60.
- **79** Zalesak M, Siu K, Francis K, Yu C, Alvrtsyan H, Rao Y, et al. Higher persistence in newly diagnosed nonvalvular atrial fibrillation patients treated with dabigatran versus warfarin. *Circulation and Cardiovascular Quality Outcomes*. 2013;**6**:567–74.
- **80** Aarnio EJ, Martikainen JA, Helin-Salmivaara A, Huupponen RK, Hartikainen JE, Peura PK, Korhonen MJ. Register-based predictors of adherence among new statin users in Finland. *Journal of Clinical Lipidology*. 2014;**8**:117–25.
- **81** Steiner JF, Ho PM, Beaty BL, Dickinson LM, Hanratty R, Zeng C, et al. Sociodemographic and clinical characteristics are not clinically useful predictors of refill adherence in patients with hypertension. *Circulation and Cardiovascular Quality Outcomes*. 2009;**2**:451–7.

- **82** Dormuth CR, Patrick AR, Shrank WH, Wright JM, Glynn RJ, Sutherland J, Brookhart MA. Statin adherence and risk of accidents: a cautionary tale. *Circulation*. 2009;**119**:2051–7.
- **83** Payne RA, Avery AJ, Duerden M, Saunders CL, Simpson CR, Abel GA. Prevalence of polypharmacy in a Scottish primary care population. *European Journal of Clinical Pharmacology*. 2014;**70**:575–81.
- **84** Eckert KA, Shi Z, Taylor AW, Wittert G, Price K, Goldney RD. Learning from an epidemiological, population-based study on prescribed medicine use in adults. *Pharmacoepidemiology & Drug Safety*. 2013;**22**:271−7.
- 85 Nobili A, Marengoni A, Tettamanti M, Salerno F, Pasina L, Franchi C, et al. Association between clusters of diseases and polypharmacy in hospitalized elderly patients: results from the REPOSI study. *European Journal of Internal Medicine*. 2011;22:597–602.
- **86** Morgado MP, Rolo SA, Pereira L, Castelo-Branco M. Blood pressure control and antihypertensive pharmacotherapy patterns in a hypertensive population of Eastern Central Region of Portugal. *BMC Health Services Research.* 2010;**10**:349.
- **87** Fleg JL, Aronow WS, Frishman WH. Cardiovascular drug therapy in the elderly: benefits and challenges. *National Reviews in Cardiology.* 2011;**8**:13–28.
- **88** Castellano JM, Sanz G, Fernandez OA, Garrido E, Bansilal S, Fuster V. A polypill strategy to improve global secondary cardiovascular prevention: from concept to reality. *Journal of the American College of Cardiology*. 2014;**64**:613–21.
- **89** Huffman MD, de Cates AN, Ebrahim S. Fixed-dose combination therapy (polypill) for the prevention of cardiovascular disease. *Journal of the American Medical Association*. 2014;**312**:2030–1.
- **90** Reddy KS. Polypill opens a path for improving adherence. *Journal of the American College of Cardiology*. 2014;**64**:2083–5.
- **91** Thom S, Poulter N, Field J, Patel A, Prabhakaran D, Stanton A, et al. Effects of a fixed-dose combination strategy on adherence and risk factors in patients with or at high risk of CVD: the UMPIRE randomized clinical trial. *Journal of the American Medical Association*. 2013;**310**:918–29.
- **92** Reeve E, Shakib S, Hendrix I, Roberts MS, Wiese MD. Review of deprescribing processes and development of an evidence based, patient-centred

- deprescribing process. *British Journal of Clinical Pharmacology*. 2014;**78**(4):738–47.
- **93** Kirchmayer U, Di Martino M, Agabiti N, Bauleo L, Fusco D, Belleudi V, et al. Effect of evidence-based drug therapy on long-term outcomes in patients discharged after myocardial infarction: a nested
- case-control study in Italy. *Pharmacoepidemiology & Drug Safety.* 2013;**22**:649−57.
- **94** Musini VM, Tejani AM, Bassett K, Wright JM. Pharmacotherapy for hypertension in the elderly. *Cochrane Database of Systematic Reviews*. 2009;CD000028.

- 1 Johannes CB, Le TK, Zhou X, Johnston JA, Dworkin RH. The prevalence of chronic pain in United States adults: results of an Internet-based survey. *Journal of Pain*. 2010;11:1230–9.
- **2** Breivik H, Collett B, Ventafridda V, Cohen R, Gallacher D. Survey of chronic pain in Europe: prevalence, impact on daily life, and treatment. *European Journal of Pain*. 2006;**10**:287–333.
- **3** IMS Health. The Use of Medicines in the United States: Review of 2010. 2011.
- 4 Therapeutic Guidelines: Analgesic Writing Group. Therapeutic Guidelines: Analgesic. In: Mashford DM, ed. *Therapeutic Guidelines: Analgesic*, 6th edn. Melbourne, Therapeutic Guidelines Ltd, 2012.
- **5** Lynch ME. Antidepressants as analgesics: a review of randomized controlled trials. *Journal of Psychiatry* & Neuroscience. 2001;**26**:30–6.
- **6** Cavagna L, Caporali R, Trifiro G, Arcoraci V, Rossi S, Montecucco C. Overuse of prescription and OTC non-steroidal anti-inflammatory drugs in patients with rheumatoid arthritis and osteoarthritis. *International Journal of Immunopathology and Pharmacology*. 2013;**26**:279–81.
- **7** Boersma K, Linton SJ. Expectancy, fear and pain in the prediction of chronic pain and disability: a prospective analysis. *European Journal of Pain*. 2006:**10**:551–7.
- **8** Dix P, Sandhar B, Murdoch J, MacIntyre PA. Pain on medical wards in a district general hospital. *British Journal of Anaesthesia*. 2004;**92**:235–7.
- **9** Langley PC. The prevalence, correlates and treatment of pain in the European Union. *Current Medical Research and Opinion*. 2011;**27**:463–80.
- **10** Freemont AJ, Hoyland JA. Morphology, mechanisms and pathology of musculoskeletal ageing. *Journal of Pathology.* 2007;**211**:252–9.

- **11** Ruau D, Liu LY, Clark JD, Angst MS, Butte AJ. Sex differences in reported pain across 11 000 patients captured in electronic medical records. *Journal of Pain*. 2012;**13**:228–34.
- **12** Amandusson A, Blomqvist A. Estrogenic influences in pain processing. *Frontiers in Neuroendocrinology*. 2013;**34**:329–49.
- 13 Reid M, Engles-Horton L, Weber M, Kerns R, Rogers E, O'Connor P. Use of Opioid Medications for Chronic Noncancer Pain Syndromes in Primary Care. *Journal of General Internal Medicine*. 2002;17:173–9.
- **14** Radat F, Margot-Duclot A, Attal N. Psychiatric co-morbidities in patients with chronic peripheral neuropathic pain: a multicentre cohort study. *European Journal of Pain*. 2013;**17**:1547–57.
- **15** Nielsen CS, Stubhaug A, Price DD, Vassend O, Czajkowski N, Harris JR. Individual differences in pain sensitivity: genetic and environmental contributions. *Pain*. 2008;**136**:21–9.
- 16 Broekmans S, Dobbels F, Milisen K, Morlion B, Vanderschueren S. Pharmacologic pain treatment in a multidisciplinary pain center do patients adhere to the prescription of the physician? *Clinical Journal of Pain*. 2010;26:81–6.
- 17 Dubois R, Melmed GY, Henning J, Laine L. Guidelines for the appropriate use of non-steroidal anti-inflammatory drugs, cyclo-oxygenase-2-specific inhibitors and proton pump inhibitors in patients requiring chronic anti-inflammatory therapy. *Alimentary Pharmacology & Therapeutics*. 2004;19:197–208.
- **18** Rahme E, Joseph L, Kong SX, Watson DJ, LeLorier J. Cost of prescribed NSAID-related gastrointestinal adverse events in elderly patients. *British Journal of Clinical Pharmacology*. 2001;**52**:185–92.
- 19 Barozzi N, Tett SE. Perceived barriers to paracetamol (acetaminophen) prescribing, especially follow-

- ing rofecoxib withdrawal from the market. *Clinical Rheumatology*. 2009;**28**:509–19.
- **20** Flemming K. The use of morphine to treat cancer-related pain: a synthesis of quantitative and qualitative research. *Journal of Pain and Symptom Management*. 2010;**39**:139–54.
- **21** Spitz A, Moore AA, Papaleontiou M, Granieri E, Turner BJ, Reid MC. Primary care providers' perspective on prescribing opioids to older adults with chronic non-cancer pain: a qualitative study. *BMC Geriatrics*. 2011;**11**:35.
- **22** Barreto PD, Lapeyre-Mestre M, Vellas B, Rolland Y. Potential underuse of analgesics for recognized pain in nursing home residents with dementia: a cross-sectional study. *Pain*. 2013;**154**:2427–31.
- 23 United Nations Office on Drugs and Crime. The Non-Medical Use of Prescription Drugs. Policy Direction Issues. Vienna, United Nations, 2011: 1–96.
- **24** Weston AL, Weinstein AM, Barton C, Yaffe K. Potentially inappropriate medication use in older adults with mild cognitive impairment. *Journals of Gerontology A Biological Sciences and Medical Sciences*. 2010:**65**:318–21.
- **25** McLean CP, Asnaani A, Litz BT, Hofmann SG. Gender differences in anxiety disorders: prevalence, course of illness, comorbidity and burden of illness. *Journal of Psychiatric Research*. 2011;**45**:1027–35.
- **26** Allen JP, Chango J, Szwedo D, Schad M, Marston E. Predictors of susceptibility to peer influence regarding substance use in adolescence. *Child Development*. 2012:**83**:337–50.
- **27** Volkow ND. *Prescription Drugs: Abuse and Addiction*. Bethesda, MD, National Institute on Drug Abuse, 2011.
- 28 Australian Medicines Handbook. Adelaide, Australian Medicines Handbook Pty Ltd, 2014.
- **29** Alexander GC, Gallagher SA, Mascola A, Moloney RM, Stafford RS. Increasing off-label use of antipsychotic medications in the United States, 1995–2008. *Pharmacoepidemiology & Drug Safety*. 2011;**20**:177–84.
- **30** O'Brien A. Starting clozapine in the community: a UK perspective. *CNS Drugs*. 2004;**18**:845–52.
- **31** Woods D. *New Zealand Formulary*. Dunedin, New Zealand Formulary, 2014.
- **32** Ronsley R, Scott D, Warburton WP, Hamdi RD, Louie DC, Davidson J, Panagiotopoulos C. A

- population-based study of antipsychotic prescription trends in children and adolescents in British Columbia, from 1996 to 2011. *Canadian Journal of Psychiatry*. 2013;**58**:361–9.
- **33** Alessi-Severini S, Dahl M, Schultz J, Metge C, Raymond C. Prescribing of psychotropic medications to the elderly population of a Canadian province: a retrospective study using administrative databases. *PeerJ.* 2013;**1**:e168.
- **34** Brunton LL, Lazo JS, Parker KL. *Goodman & Gilman's The Pharmacological Basis of Therapeutics*. New York, McGrawHill. 2006.
- **35** Lacro JP, Dunn LB, Dolder CR, Leckband SG, Jeste DV. Prevalence of and risk factors for medication nonadherence in patients with schizophrenia: a comprehensive review of recent literature. *Journal of Clinical Psychiatry*. 2002;**63**:892–909.
- **36** Birnbaum M, Sharif Z. Medication adherence in schizophrenia: patient perspectives and the clinical utility of paliperidone ER. *Patient Preference and Adherence*. 2008;**2**:233–40.
- **37** Offord S, Wong B, Mirski D, Baker RA, Lin J. Healthcare resource usage of schizophrenia patients initiating long-acting injectable antipsychotics vs oral. *Journal of Medical Economics*. 2013;**16**:231–9.
- **38** Kishimoto T, Robenzadeh A, Leucht C, Watanake K, Mimura M, Borenstein M, et al. Long-acting injectable vs oral antipsychotics for relapse prevention in schizophrenia: a meta-analysis of randomized trials. *Schizophrenia Bulletin*. 2014;**40**:192–213.
- **39** Byerly MJ, Nakonezny PA, Lescouflair E. Antipsychotic medication adherence in schizophrenia. *Psychiatric Clinics of North America*. 2007;**30**:437–52.
- **40** Stephenson CP, Karanges E, McGregor IS. Trends in the utilisation of psychotropic medications in Australia from 2000 to 2011. *Australian and New Zealand Journal of Psychiatry*. 2013;**47**:74–87.
- **41** British Medical Association and Royal Pharmaceutical Society of Great Britain. *British National Formulary*. London, British Medical Association, 2013.
- **42** van der Hooft CS, Jong GW, Dieleman JP, Verhamme KM, van der Cammen TJ, Stricker BH, Sutrkenboom MC. Inappropriate drug prescribing in older adults: the updated 2002 Beers criteria a population-based cohort study. *British Journal of Clinical Pharmacology*. 2005;**60**:137–44.

- **43** McGrath J, Saha S, Welham J, El Saadi O, MacCauley C, Chant D. A systematic review of the incidence of schizophrenia: the distribution of rates and the influence of sex, urbanicity, migrant status and methodology. *BMC Medicine*. 2004;**2**:13.
- **44** Banerjee I, Roy B, Sathian B, Banerjee I, Chakraborty PK, Saha A. Socio demographic profile and utilization pattern of antipsychotic drugs among schizophrenic inpatients: a cross sectional study from western region of Nepal. *BMC Psychiatry*. 2013;**13**:96.
- **45** Hollingworth SA, Siskind DJ, Nissen LM, Robinson M, Hall WD. Patterns of antipsychotic medication use in Australia 2002–2007. *Australian and New Zealand Journal of Psychiatry*. 2010;**44**:372–7.
- **46** Meng X, D'Arcy C, Tempier R. Trends in psychotropic use in Saskatchewan from 1983 to 2007. *Canadian Journal of Psychiatry*. 2013;**58**:426–31.
- **47** Toh S, Li Q, Cheetham TC, Cooper W, Davis R, Dublin S, et al. Prevalence and trends in the use of antipsychotic medications during pregnancy in the US, 2001–2007: a population-based study of 585 615 deliveries. *Archives of Women's Mental Health*. 2013:**16**:149–57.
- **48** Ng CG, Boks MP, Smeets HM, Zainal NZ, de Wit NJ. Prescription patterns for psychotropic drugs in cancer patients; a large population study in the Netherlands. *Psycho-oncology*. 2013;**22**:762–7.
- **49** Gorevski E, Bian B, Kelton CM, Boone JEM, Guo JJ. Utilization, spending, and price trends for benzodiazepines in the US Medicaid program: 1991–2009. *Annals of Pharmacotherapy*. 2012;**46**:503–12.
- 50 Lasserre A, Younès N, Blanchon T, Cantegreil-Kallen I, Passerieux C, Thomas G, et al. Psychotropic drug use among older people in general practice: discrepancies between opinion and practice. *British Journal of General Practice*. 2010;60:e156–62.
- **51** Smith A, Sketris I, Cooke C, Gardner D, Kisely S, Tett S. A comparison of benzodiazepines and related drug use in Nova Scotia, Canada and Australia. *Canadian Journal of Psychiatry*. 2008;**53**: 545–52.
- **52** Smith A, Tett S. How do different age groups use benzodiazepines and antidepressants? Analysis of an Australian administrative database, 2003–6. *Drugs and Aging*. 2009;**26**:113–22.
- 53 Alessi-Severini S, Bolton JM, Enns MW, Dahl M, Collins DM, Chateau D, Sareen J. Use of

- benzodiazepines and related drugs in Manitoba: a population-based study. *Canadian Medical Association Open Access Journal*. 2014;**2**:E208–16.
- 54 Linjakumpu T, Hartikainen S, Klaukka T, Koponen H, Kivela SL, Isoaho R. Psychotropics among the home-dwelling elderly increasing trends. *International Journal of Geriatric Psychiatry*. 2002;17:874–83.
- 55 Pringsheim T, Gardner DM. Dispensed prescriptions for quetiapine and other second-generation antipsychotics in Canada from 2005 to 2012: a descriptive study. *Canadian Medical Association Open Access Journal*. 2014;**2**:E225–32.
- 56 McGrath J, Saha S, Chant D, Welham J. Schizophrenia: a concise overview of incidence, prevalence, and mortality. *Epidemiologic Reviews*. 2008;30:67–76.
- **57** Chen Y, Briesacher BA, Field TS, Tjia J, Lau DT, Gurwitz JH. Unexplained variation across US nursing homes in antipsychotic prescribing rates. *Archives of Internal Medicine*. 2010;**170**:89–95.
- 58 Gustafsson M, Karlsson S, Lovheim H. Inappropriate long-term use of antipsychotic drugs is common among people with dementia living in specialized care units. *BMC Pharmacology and Toxicology*. 2013;14:10.
- **59** Seida JC, Schouten JR, Mousavi SS, Hamm M, Beaith A, Vandermeer B, et al. First- and second-generation antipsychotics for children and young adults. *Comparative Effectiveness Reviews*. 2012;**39**:11(12)-EHC077-EF.
- **60** Smith A, Tett S. Improving the use of benzodiazepines Is it possible? A non-systematic review of interventions tried in the last 20 years. *BMC Health Services Research*. 2010;**10**:321.
- **61** Azermai M, Elseviers M, Petrovic M, Van Bortel L, Vander Stichele R. Geriatric drug utilisation of psychotropics in Belgian nursing homes. *Human Psychopharmacology*. 2011;**26**:12–20.
- **62** Cumming RG, Le Couteur DG. Benzodiazepines and risk of hip fractures in older people: a review of the evidence. *CNS Drugs*. 2003;**17**:825–37.
- **63** Hollingworth SA, Siskind DJ. Anxiolytic, hypnotic and sedative medication use in Australia. *Pharmacoepidemiology and Drug Safety*. 2010;**19**:280–8.
- **64** Siriwardena AN, Qureshi MZ, Dyas JV, Middleton H, Orner R. Magic bullets for insomnia? Patients' use and experiences of newer (Z drugs) versus older

- (benzodiazepine) hypnotics for sleep problems in primary care. *British Journal of General Practice*. 2008;**58**:417–22.
- **65** Williams JJW, Mulrow CD, Chiquette E, Noël PH, Aguilar C, Cornell J. A systematic review of newer pharmacotherapies for depression in adults: evidence report summary: clinical guideline, Part 2. *Annals of Internal Medicine*. 2000; **132**:743–56.
- **66** Anderson IM. Selective serotonin reuptake inhibitors versus tricyclic antidepressants: a meta-analysis of efficacy and tolerability. *Journal of Affective Disorders*. 2000;**58**:19–36.
- 67 Connor DF, In R. Stimulants. In: Barkley RA, ed. Attention Deficit/Hyperactivity Disorder: A Handbook for Diagnosis and Treatment, 3rd edn. New York, Guilford Press, 2005: 608–47.
- **68** Moriyama TS, Polanczyk GV, Terzi FS, Faria KM, Rohde LA. Psychopharmacology and psychotherapy for the treatment of adults with ADHD a systematic review of available meta-analyses. *CNS Spectrums*. 2013:1–11.
- **69** Solomon CG, Volkow ND, Swanson JM. Adult attention deficit–hyperactivity disorder. *New England Journal of Medicine*. 2013;**369**:1935–44.
- **70** Shaw M, Hodgkins P, Caci H, Yougn S, Kahle J, Woods AG, Arnold LE. A systematic review and analysis of long-term outcomes in attention deficit hyperactivity disorder: effects of treatment and non-treatment. *BMC Medicine*. 2012;**10**:99.
- 71 Banaschewski T, Coghill D, Santosh P, et al. Long-acting medications for the hyperkinetic disorders: a systematic review and European treatment guideline. *European Child & Adolescent Psychiatry*. 2006;**15**:476–95.
- 72 Hammerness P, McCarthy K, Mancuso E, Gendron C, Geller D. Atomoxetine for the treatment of attention-deficit/hyperactivity disorder in children and adolescents: a review. *Neuropsychiatric Disease and Treatment*. 2009;**5**:215.
- **73** Safer DJ, Zito JM. Concomitant psychotropic medication for youths. *American Journal of Psychiatry*. 2003;**160**:438–49.
- 74 Ahmed R, Aslani P. Attention-deficit/hyperactivity disorder: an update on medication adherence and persistence in children, adolescents and adults. *Expert Review of Pharmacoeconomics & Outcomes Research*. 2013:13:791–815.

- **75** Olfson M, Marcus SC, Zhang HF, Wan GJ. Continuity in methylphenidate treatment of adults with attention-deficit/hyperactivity disorder. *Journal of Managed Care Pharmacy*. 2007;**13**:570.
- 76 Bokhari FA, Heiland F, Levine P, Ray GT. Risk factors for discontinuing drug therapy among children with ADHD. *Health Services and Outcomes Research Method*ology. 2008;8:134–58.
- 77 Geirs DP, Pottegård A, Halldórsson M, Zoëga H. A nationwide study of ADHD drug use among adults in Iceland 2003–2012. *Basic & Clinical Pharmacology & Toxicology*. 2014;**115**(5):417–22.
- 78 Barkley RA, McMurray MB, Edelbrock CS, Robbins K. Side effects of metlyiphenidate in children with attention deficit hyperactivity disorder: a systemic, placebo-controlled evaluation. *Pediatrics*. 1990;86:184–92.
- **79** Gould MS, Walsh BT, Munfakh JL, Kleinman M, Duan N, Olfson M, et al. Sudden death and use of stimulant medications in youths. *American Journal of Psychiatry*. 2009;**166**:992–1001.
- **80** Nissen SE. ADHD drugs and cardiovascular risk. *New England Journal of Medicine*. 2006;**354**:1445–8.
- **81** Cooper WO, Habel LA, Sox CM, Chan, KA, Arbogast PG, Cheetham C, et al. ADHD drugs and serious cardiovascular events in children and young adults. *New England Journal of Medicine*. 2011;**365**:1896–904.
- **82** Mathers CD, Fat DM, Boerma J. *The Global Burden of Disease: 2004 Update*. Geneva, World Health Organization, 2008.
- **83** Lee AM, Lam SK, Lau SMSM, Chong CSY, Chui HW, Fong DYT. Prevalence, course, and risk factors for antenatal anxiety and depression. *Obstetrics & Gynecology*. 2007;**110**:1102−12.
- **84** Regier DA, Boyd JH, Burke JD Jr, Rae DS, Myers JK, Kramer M, et al. One-month prevalence of mental disorders in the United States: based on five Epidemiologic Catchment Area sites. *Archives of General Psychiatry*. 1988;**45**:977.
- **85** Rodda J, Walker Z, Carter J. Depression in older adults. *British Medical Journal*. 2011;**343**:d5219.
- **86** Bryant C, Jackson H, Ames D. The prevalence of anxiety in older adults: methodological issues and a review of the literature. *Journal of Affective Disorders*. 2008;**109**:233–50.
- **87** Polanczyk G, de Lima M, Horta B, Biederman J, Rohde L. The worldwide prevalence of ADHD: a

- systematic review and metaregression analysis. *American Journal of Psychiatry*. 2007;**164**:942–8.
- **88** Simon V, Czobor P, Bálint S, Mészáros Á, Bitter I. Prevalence and correlates of adult attention-deficit hyperactivity disorder: meta-analysis. *British Journal of Psychiatry*. 2009;**194**:204–11.
- **89** Visser SN, Danielson ML, Bitsko RH, Holbrook JR, Kogan MD, Ghandour RM, et al. Trends in the parent-report of health care provider-diagnosed and medicated attention-deficit/hyperactivity disorder: United States, 2003–2011. *Journal of the American Academy of Child & Adolescent Psychiatry*. 2014;**53**:34–46, e2.
- **90** Zoega H, Furu K, Halldorsson M, Thomsen PH, Sourander A, Martikainen J. Use of ADHD drugs in the Nordic countries: a population-based comparison study. *Acta Psychiatrica Scandinavica*. 2011;**123**:360–7.
- **91** Zoëga H, Valdimarsdóttir UA, Hernández-Díaz S. Age, academic performance, and stimulant prescribing for ADHD: a nationwide cohort study. *Pediatrics*. 2012;**130**:1012–18.
- **92** Cox ER, Motheral BR, Henderson RR, Mager D. Geographic variation in the prevalence of stimulant medication use among children 5 to 14 years old: results from a commercially insured US sample. *Pediatrics*. 2003;**111**:237–43.
- **93** Helgason T, Tómasson H, Zoega T. Antidepressants and public health in Iceland Time series analysis of national data. *British Journal of Psychiatry*. 2004;**184**:157–62.
- 94 IMS Institute for Healthcare Informatics. The Use of Medicines in the United States: Review of 2011. Available from: http://www.environmental healthnews.org/ehs/news/2013/pdf-links/IHII_Medicines_in_U.S_Report_2011-1.pdf (last accessed 18 November 2015).
- **95** Mojtabai R, Olfson M. Proportion of antidepressants prescribed without a psychiatric diagnosis is growing. *Health Affairs*. 2011;**30**:1434–42.
- **96** Geddes JR, Carney SM, Davies C, Furukawa TA, Kupfer DJ, Frank E, Goodwin GM. Relapse prevention with antidepressant drug treatment in depressive disorders: a systematic review. *Lancet*. 2003;**361**:653–61.
- **97** Vitiello B, Swedo S. Antidepressant medications in children. *New England Journal of Medicine*. 2004;**350**:1489–91.

- 98 Bridge JA, Iyengar S, Salary CB, Barbe RP, Birmaher B, Pincus HA, et al. Clinical response and risk for reported suicidal ideation and suicide attempts in pediatric antidepressant treatment: a meta-analysis of randomized controlled trials. *Journal of the American Medical Association*. 2007;297:1683–96.
- **99** Simon GE, Savarino J, Operskalski B, Wang PS. Suicide risk during antidepressant treatment. *American Journal of Psychiatry*. 2006;**163**:41–7.
- **100** Pottegård A, Zoëga H, Hallas J, Damkier P. Use of SSRIs among Danish children: a nationwide study. *European Child & Adolescent Psychiatry*. 2014:**23**(12):1211−18.
- **101** Zuvekas SH, Vitiello B. Stimulant medication use among US children: a twelve-year perspective. *American Journal of Psychiatry*. 2012;**169**:160.
- 102 McCarthy S, Wilton L, Murray M, Hodgkins P, Asherson P, Wong I. The epidemiology of pharmacologically treated attention deficit hyperactivity disorder (ADHD) in children, adolescents and adults in UK primary care. *BMC Pediatrics*. 2012;12:78.
- **103** Scheffler RM, Hinshaw SP, Modrek S, Levine P. The global market for ADHD medications. *Health Affairs (Project Hope)*. 2007;**26**:450–7.
- **104** Humphreys KL, Eng T, Lee SS. Stimulant medication and substance use outcomes: a meta-analysis. *Journal of the American Medical Association Psychiatry*. 2013:**70**(7):740–9.
- 105 Lichtenstein P, Halldner L, Zetterqvist J, Sjölander A, Serlachius E, Fazel S, et al.. Medication for attention deficit–hyperactivity disorder and criminality. New England Journal of Medicine. 2012;367:2006–14.
- 106 Chang Z, Lichtenstein P, D'Onofrio BM, Sjölander A, Larsson H. Serious transport accidents in adults with attention-deficit/hyperactivity disorder and the effect of medication: a population-based study. *Journal of the American Medical Association Psychiatry*. 2014;71(3):319–25.
- **107** Setlik J, Bond GR, Ho M. Adolescent prescription ADHD medication abuse is rising along with prescriptions for these medications. *Pediatrics*. 2009;**124**:875–80.
- 108 World Health Organization. Mental Health Action Plan 2013. Available from: http://www.who.int/mental_health/publications/action_plan/en/ (last accessed 18 November 2015).

- 1 Agency for Healthcare Research and Quality. Registries for Evaluating Patient Outcomes: A User's Guide, 2nd edn. Available from: http://effectivehealthcare.ahrq. gov/ehc/products/74/531/Registries%202nd%20 ed%20final%20to%20Eisenberg%209-15-10.pdf (last accessed 18 November 2015).
- **2** Kennedy L, Craig AM. Global registries for measuring pharmacoeconomic and quality-of-life outcomes: focus on design and data collection, analysis and interpretation. *Pharmacoeconomics*. 2004;**22**(9):551–68.
- **3** Eichler HG, Abadie E, Breckenridge A, Flamion B, Gustafsson LL, Leufkens H, et al. Bridging the efficacy–effectiveness gap: a regulator's perspective on addressing variability of drug response. *Nature Reviews Drug Discovery.* 2011;**10**(7):495–506.
- **4** Lauer MS, D'Agostino RB Sr. The randomized registry trial the next disruptive technology in clinical research? *New England Journal of Medicine*. 2013;**369**(17):1579–81.
- **5** Lagerqvist B, Fröbert O, Olivecrona GK, Gudnason T, Maeng M, Alström P, et al. New England Journal of Medicine. 2014; 18;**371**(12):1111–20.
- **6** Multiple Sclerosis International Federation. Atlas of MS 2013: Mapping of Multiple Scleoris around the World. Available from: http://www.msif.org/wp-content/uploads/2014/09/Atlas-of-MS.pdf (last accessed 18 November 2015).
- **7** Piehl F. A changing treatment landscape for multiple sclerosis: challenges and opportunities. *Journal of Internal Medicine*. 2014;**275**(4):364–81.
- **8** Flachenecker P, Stuke K. National MS registries. *Journal of Neurology*. 2008;**255**(Suppl. 6):102–8.
- **9** Hurwitz BJ. Registry studies of long-term multiple sclerosis outcomes: description of key registries. *Neurology.* 2011;**76**(1 Suppl. 1):S3–6.

- 10 Confavreux C, Compston DA, Hommes OR, McDonald WI, Thompson AJ. EDMUS, a European database for multiple sclerosis. *Journal of Neurology, Neurosurgery and Psychiatry*. 1992;55(8):671-6.
- 11 Butzkueven H, Chapman J, Cristiano E, Grand' Maison F, Hoffmann M, Izquierdo G, et al. MSBase: an international, online registry and platform for collaborative outcomes research in multiple sclerosis. *Multiple Sclerosis*. 2006;12(6):769–74.
- 12 Bronnum-Hansen H, Koch-Henriksen N, Stenager E. The Danish Multiple Sclerosis Registry. *Scandinavian Journal of Public Health*. 2011;39(7 Suppl.):62–4.
- 13 Myhr KM, Grytten N, Aarseth JH, Nyland H. The Norwegian Multiple Sclerosis National Competence Centre and National Multiple Sclerosis registry a resource for clinical practice and research. *Acta Neurologica Scandinavica. Supplementum.* 2006;183:37–40.
- **14** Andersen O. From the Gothenburg cohort to the Swedish multiple sclerosis registry. *Acta Neurologica Scandinavica. Supplementum.* 2012;**195**:13–19.
- 15 Trojano M, Paolicelli D, Lepore V, Fuiani A, Di Monte E, Pellegrini F, et al.; Italian MSDN Group. Italian Multiple Sclerosis Database Network. *Neurological Science*. 2006;**27**(Suppl. 5):S358–61.
- **16** Stuke K, Flachenecker P, Zettl UK, Elias WG, Freidel M, Haas J, et al. Symptomatology of MS: results from the German MS Registry. *Journal of Neurology*. 2009;**256**(11):1932–5.
- 17 Fox RJ, Salter AR, Tyry T, Sun J, You X, Laforet G, et al. Treatment discontinuation and disease progression with injectable disease-modifying therapies: findings from the North American research committee on multiple sclerosis database. *International Journal of Multiple Sclerosis Care*. 2013;15(4):194–201.

- **18** Scalfari A, Neuhaus A, Daumer M, Ebers GC, Muraro PA. Age and disability accumulation in multiple sclerosis. *Neurology*. 2011;**77**(13):1246–52.
- **19** Scalfari A, Neuhaus A, Daumer M, Muraro PA, Ebers GC. Onset of secondary progressive phase and long-term evolution of multiple sclerosis. *Journal of Neurology, Neurosurgery and Psychiatry.* 2014;**85**(1):67–75.
- 20 Ionescu I, Frangoulis B, Vukusic S, Contafavreux C; for the EDMUS Group. EDMUS, an international, user-friendly and evolutive database for multiple sclerosis patients. Available from: http://registration.akm.ch/einsicht.php?XNABSTRACT_ID=137863&XNSPRACHE_ID=1&XNKONGRESS_ID=150&XNMASKEN_ID=900 (last accessed 18 November 2015).
- 21 MSBase Foundation website: www.msbase.org.
- **22** Jokubaitis VG, Spelman T, Lechner-Scott J, Barnett M, Shaw C, Vucic S, et al. The Australian Multiple Sclerosis (MS) immunotherapy study: a prospective, multicentre study of drug utilisation using the MSBase platform. *PLoS ONE*. 2013;**8**(3):e59694.
- **23** Wong J, Gomes T, Mamdani M, Manno M, O'Connor PW. Adherence to multiple sclerosis disease-modifying therapies in Ontario is low. *Canadian Journal of Neurological Science*. 2011;**38**(3):429–33.
- **24** Sorensen PS, Koch-Henriksen N, Ravnborg M, Frederiksen JL, Jensen K, Heltberg A, et al. Immunomodulatory treatment of multiple sclerosis in Denmark: a prospective nationwide survey. *Multiple Sclerosis*. 2006;**12**(3):253–64.
- **25** Trojano M, Pellegrini F, Paolicelli D, Fuiani A, Zimatore GB, Tortorella C, et al. Real-life impact of early interferon beta therapy in relapsing multiple sclerosis. *Annals of Neurology*. 2009;**66**(4):513–20.
- **26** Lebrun C, Debouverie M, Jeannin S, Pittion-Vouyovitch S, Bayreuther C, Berthier F. Impact of disease-modifying treatments in North African migrants with multiple sclerosis in France. *Multiple Sclerosis*. 2008;**14**(7):933–9.
- **27** von Andrian UH, Engelhardt B. Alpha4 integrins as therapeutic targets in autoimmune disease. *New England Journal of Medicine*. 2003;**348**(1):68–72.
- **28** Polman CH, O'Connor PW, Havrdova E, Hutchinson M, Kappos L, Miller DH, et al. A randomized, placebo-controlled trial of natalizumab for relapsing multiple sclerosis. *New England Journal of Medicine*. 2006;**354**(9):899–910.

- **29** Neovius M, Arkema EV, Olsson H, Eriksson JK, Kristensen LE, Simard JF, et al. Drug survival on TNF inhibitors in patients with rheumatoid arthritis comparison of adalimumab, etanercept and infliximab. *Annals of the Rheumatic Diseases*. 2015;**74**(2):354–60.
- 30 Askling J, Baecklund E, Granath F, Geborek P, Fored M, Backlin C, et al. Anti-tumour necrosis factor therapy in rheumatoid arthritis and risk of malignant lymphomas: relative risks and time trends in the Swedish Biologics Register. Annals of the Rheumatic Diseases. 2009;68(5):648–53.
- 31 Rudick RA, Stuart WH, Calabresi PA, Confavreux C, Galetta SL, Radue EW, et al. Natalizumab plus interferon beta-1a for relapsing multiple sclerosis. *New England Journal of Medicine*. 2006;354(9):911–23.
- **32** The Tysabri Touch Prescribing Program. Available from: http://www.tysabri.com/safety-with-tysabri. xml (last accessed 18 November 2015).
- 33 European Medicines Agency. Tysabri European Public Assessment Report. Available from: http://www.ema.europa.eu/ema/index.jsp?curl=pages/medicines/human/medicines/000603/human_med_001119.jsp&mid=WC0b01ac058001d124 (last accessed 18 November 2015).
- **34** Yousry TA, Major EO, Ryschkewitsch C, Fahle G, Fischer S, Hou J, et al. Evaluation of patients treated with natalizumab for progressive multifocal leukoencephalopathy. *New England Journal of Medicine*. 2006;**354**(9):924–33.
- 35 Sacripanti C, Piccinni C, Puccini A, Poluzzi E, Montanaro N. Analyses of natalizum abprescriptions and discontinuations in multiple sclerosis patients of an Italian region. ISPE/EuroDURG Better Public Health Through Pharmacoepidemiology and Quality of Use of Medicine, 30 November–3 December 2011, Antwerp, Belgium.
- **36** Mancardi GL, Amato MP, D'Alessandro R, Drago F, Milanese C, Popoli P, et al. Natalizumab: a country-based surveillance program. *Neurological Science*. 2008;**29**(Suppl. 2):S235–7.
- **37** Tedeschi G, Amato MP, D'Alessandro R, Drago F, Milanese C, Popoli P, et al. The pharmacovigilance program on natalizumab in Italy: 2 years of experience. *Neurological Science*. 2009;**30**(Suppl. 2):S163–5.
- **38** Mancardi GL, Tedeschi G, Amato MP, D'Alessandro R, Drago F, Milanese C, et al. Three years of experience: the Italian registry and safety data update. *Neurological Science*. 2011;**31**(Suppl. 3):295–7.

- **39** Butzkueven H, Kappos L, Pellegrini F, Trojano M, Wiendl H, Patel RN, et al. Efficacy and safety of natalizumab in multiple sclerosis: interim observational programme results. *Journal of Neurology, Neurosurgery and Psychiatry*. 2014;**85**(11):1190–7.
- **40** Holmen C, Piehl F, Hillert J, Fogdell-Hahn A, Lundkvist M, Karlberg E, et al. A Swedish national post-marketing surveillance study of natalizumab treatment in multiple sclerosis. *Multiple Sclerosis*. 2011;**17**(6):708–19.
- **41** EDMUS Study Group. TYSEDMUS Study. Available from: http://www.edmus.org/en/dl/tys/TYSEDMUS_Synopsis.pdf(lastaccessed18November 2015).
- 42 Committee for Medicinal Products for Human Use. Assessment Report: Tysabri. International Non-Proprietary Name: Natalizumab. Procedure No. EMEA/H/C/000603/II/0059/G. Available from: http://www.ema.europa.eu/docs/en_GB/document_library/EPAR_-_Assessment_Report_-_Variation/human/000603/WC500148205.pdf (last accessed 18 November 2015).
- 43 Piccinni C, Sacripanti C, Poluzzi E, Motola D, Magro L, Moretti U, et al. Stronger association of drug-induced progressive multifocal leukoencephalopathy (PML) with biological immunomodulating agents. *European Journal of Clinical Pharmacology*. 2010;66(2):199–206.
- **44** Piccinni C, Sacripanti C, Poluzzi E, De Ponti F. Disproportionality signal of progressive multifocal leukoencephalopathy: monoclonal antibodies versus other immunosuppressants. *Pharmacoepidemiology & Drug Safety.* 2013;**22**(4):443–5.
- **45** Alamanos Y, Voulgari PV, Drosos AA. Incidence and prevalence of rheumatoid arthritis, based on the 1987 American College of Rheumatology criteria: a systematic review. *Seminars in Arthritis and Rheumatism*. 2006;**36**(3):182–8.
- **46** Neovius M, Simard JF, Askling J. Nationwide prevalence of rheumatoid arthritis and penetration of disease-modifying drugs in Sweden. *Annals of the Rheumatic Diseases*. 2011;**70**(4):624–9.
- 47 Chen YF, Jobanputra P, Barton P, Jowett S, Bryan S, Clark W, et al. A systematic review of the effectiveness of adalimumab, etanercept and infliximab for the treatment of rheumatoid arthritis in adults and an economic evaluation of their

- cost-effectiveness. Health Technology Assessment. 2006;10(42):iii-xiii, 1.
- **48** Askling J, Dixon W. The safety of anti-tumour necrosis factor therapy in rheumatoid arthritis. *Current Opinions in Rheumatology*. 2008;**20**(2):138–44.
- **49** Jonsson B, Kobelt G, Smolen J. The burden of rheumatoid arthritis and access to treatment: uptake of new therapies. *European Journal of Health Economics*. 2008;**8**(Suppl. 2):S61–86.
- **50** Sangiorgi D, Benucci M, Nappi C, Perrone V, Buda S, Degli Esposti L. Drug usage analysis and health care resources consumption in naïve patients with rheumatoid arthritis. Biologics. 2015;9:119–27.
- **51** Simard JF, Arkema EV, Sundstrom A, Geborek P, Saxne T, Baecklund E, et al. Ten years with biologics: to whom do data on effectiveness and safety apply? *Rheumatology*. 2011;**50**(1):204–13.
- **52** Dixon WG, Carmona L, Finckh A, Hetland ML, Kvien TK, Landewe R, et al. EULAR points to consider when establishing, analysing and reporting safety data of biologics registers in rheumatology. *Annals of the Rheumatic Diseases*. 2010;**69**(9): 1596–602.
- **53** Askling J, Fored CM, Geborek P, Jacobsson LT, van VR, Feltelius N, et al. Swedish registers to examine drug safety and clinical issues in RA. *Annals of the Rheumatic Diseases*. 2006;**65**(6):707–12.
- **54** Neovius M, Simard J, Sundstrom A, Jacobsson L, Geborek P, Saxne T, et al. Generalisability of clinical registers used for drug safety and comparative effectiveness research: coverage of the Swedish Biologics Register. *Annals of the Rheumatic Diseases*. 2011;**70**(3):516–19.
- 55 Wadström H, Eriksson J, Neovius M, Askling J. How good is the coverage and how accurate are exposure data in the Swedish Biologics Register (ARTIS)? *Scandinavian Journal of Rheumatology*. 2015;44(1):22–28.
- **56** Wettermark B, Hammar N, Fored CM, Leimanis A, Otterblad OP, Bergman U, et al. The new Swedish Prescribed Drug Register opportunities for pharmacoepidemiological research and experience from the first six months. *Pharmacoepidemiology & Drug Safety*. 2007;**16**(7):726–35.
- **57** Cars T, Wettermark B, Malmstrom RE, Ekeving G, Vikstrom B, Bergman U, et al. Extraction of electronic health record data in a hospital setting: comparison of automatic and semi-automatic methods

- using anti-TNF therapy as model. *Basic Clinical Pharmacology & Toxicology*. 2013;**112**(6):392–400.
- 58 Askling J, Fored CM, Baecklund E, Brandt L, Backlin C, Ekbom A, et al. Haematopoietic malignancies in rheumatoid arthritis: lymphoma risk and characteristics after exposure to tumour necrosis factor antagonists. *Annals of the Rheumatic Diseases*. 2005;64(10):1414–20.
- **59** Askling J, Fored CM, Brandt L, Baecklund E, Bertilsson L, Feltelius N, et al. Risks of solid cancers in patients with rheumatoid arthritis and after treatment with tumour necrosis factor antagonists. *Annals of the Rheumatic Diseases*. 2005;**64**(10):1421–6.
- **60** Simard JF, Neovius M, Hagelberg S, Askling J. Juvenile idiopathic arthritis and risk of cancer: a nationwide cohort study. *Arthritis and Rheumatism*. 2010;**62**(12):3776–82.
- 61 Simard JF, Neovius M, Askling J. Mortality rates in patients with rheumatoid arthritis treated with tumor necrosis factor inhibitors: drug-specific comparisons in the Swedish Biologics Register. Arthritis and Rheumatism. 2012;64(11):3502–10.
- **62** Neovius M, Sundstrom A, Simard J, Wettermark B, Cars T, Feltelius N, et al. Small-area variations in sales of TNF inhibitors in Sweden between 2000 and 2009. *Scandinavian Journal of Rheumatology*. 2011;**40**(1):8–15.
- **63** Eriksson JK, Johansson K, Askling J, Neovius M. Costs for hospital care, drugs and lost work days in incident and prevalent rheumatoid arthritis: how large, and how are they distributed? *Annals of the Rheumatic Diseases*. 2015;**74**(4):648–54.
- **64** Neovius M, Simard JF, Klareskog L, Askling J. Sick leave and disability pension before and after initiation of antirheumatic therapies in clinical practice. *Annals of the Rheumatic Diseases*. 2011;**70**(8):1407–14.
- 65 Scott DL, Ibrahim F, Farewell V, O'Keeffe AG, Walker D, Kelly C, et al. Tumour necrosis factor inhibitors versus combination intensive therapy with conventional disease modifying anti-rheumatic drugs in established rheumatoid arthritis: TACIT non-inferiority randomised controlled trial. BMJ. 2015;350:h1046.
- **66** Eriksson JK, Neovius M, Bratt J, Petersson IF, van Vollenhoven RF, Geborek P, et al. Biological vs. conventional combination treatment and work loss in early rheumatoid arthritis: a randomized trial. *Jour-*

- nal of the American Medical Association Internal Medicine. 2013;173(15):1407–14.
- 67 Eriksson JK, Karlsson JA, Bratt J, Petersson IF, van Vollenhoven RF, Ernestam S, et al. Cost-effectiveness of infliximab versus conventional combination treatment in methotrexate-refractory early rheumatoid arthritis: 2-year results of the register-enriched randomised controlled SWEFOT trial. *Annals of the Rheumatic Diseases*. 2015;74(6):1094–101.
- **68** van Vollenhoven RF, Geborek P, Forslind K, Albertsson K, Ernestam S, Petersson IF, et al. Conventional combination treatment versus biological treatment in methotrexate-refractory early rheumatoid arthritis: 2 year follow-up of the randomised, non-blinded, parallel-group Swefot trial. *Lancet*. 2012;**379**(9827):1712–20.
- 69 Moreland LW, O'Dell JR, Paulus HE, Curtis JR, Bathon JM, St Clair EW, et al. A randomized comparative effectiveness study of oral triple therapy versus etanercept plus methotrexate in early aggressive rheumatoid arthritis: the treatment of Early Aggressive Rheumatoid Arthritis Trial. Arthritis and Rheumatism. 2012;64(9):2824–35.
- **70** O'Dell JR, Mikuls TR, Taylor TH, Ahluwalia V, Brophy M, Warren SR, et al. Therapies for active rheumatoid arthritis after methotrexate failure. *New England Journal of Medicine*. 2013;**369**(4):307–18.
- 71 Mottonen T, Hannonen P, Leirisalo-Repo M, Nissila M, Kautiainen H, Korpela M, et al. Comparison of combination therapy with single-drug therapy in early rheumatoid arthritis: a randomised trial. FIN-RACo trial group. *Lancet*. 1999;353(9164):1568–73.
- 72 Puolakka K, Kautiainen H, Mottonen T, Hannonen P, Korpela M, Julkunen H, et al. Impact of initial aggressive drug treatment with a combination of disease-modifying antirheumatic drugs on the development of work disability in early rheumatoid arthritis: a five-year randomized followup trial. *Arthritis and Rheumatism.* 2004;**50**(1):55–62.
- **73** Belge K, Brück J, Ghoreschi K. Advances in treating psoriasis. *F1000Prime Reports*. 2014;**6**:4. doi:10.12703/P6-4.
- **74** Ormerod AD, Augustin M, Baker C, Chosidow O, Cohen AD, Dam TN, et al. Challenges for synthesising data in a network of registries for systemic psoriasis therapies. *Dermatology*. 2012;**224**(3):236–43.

- **75** Nijsten T, Wakkee M. Psocare: Italy shows the way in postmarketing studies. *Dermatology*. 2008; **217**(4):362–4.
- 76 Italian Medicines Agency. Comunicato Stampa 169: Dichiarazioni Direttore Generale Aifa su uso illecito farmaci in dermatologia. Available from: http://www.agenziafarmaco.gov.it/it/content/dichiarazioni-direttore-generale-aifa-su-uso-illecito-farmaci-dermatologia (last accessed 18 November 2015).
- 77 Papp KA, Strober B, Augustin M, Calabro S, Londhe A, Chevrier M. PSOLAR: design, utility, and preliminary results of a prospective, international, disease-based registry of patients with psoriasis who are receiving, or are candidates for, conventional systemic treatments or biologic agents. *Journal of Drugs in Dermatology*, 2012;**11**(10):1210–17.
- **78** Garcia-Doval I, Carretero G, Vanaclocha F, Ferrandiz C, Dauden E, Sanchez-Carazo JL, et al. Risk of serious adverse events associated with biologic and nonbiologic psoriasis systemic therapy: patients ineligible vs eligible for randomized controlled trials. *Archives of Dermatology*. 2012;**148**(4):463–70.
- 79 Carretero G, Ferrandiz C, Dauden E, Vanaclocha SF, Gomez-Garcia FJ, Herrera-Ceballos E, et al. Risk of adverse events in psoriasis patients receiving classic systemic drugs and biologics in a 5-year observational study of clinical practice: 2008–2013 results of the Biobadaderm registry. *Journal of the European Academy of Dermatology and Venereology*. 2015;29(1):156–63.
- **80** Svedbom A, Dalen J, Mamolo C, Cappelleri JC, Petersson IF, Stahle M. Treatment patterns with topicals, traditional systemics and biologics in psoriasis a Swedish database analysis. *Journal of the European Academy of Dermatology and Venereology*. 2015;**29**(2):215–23.
- **81** Ahlehoff O, Skov L, Gislason G, Gniadecki R, Iversen L, Bryld LE, et al. Cardiovascular outcomes and systemic anti-inflammatory drugs in patients with severe psoriasis: 5-year follow-up of a Danish nationwide cohort. *Journal of the European Academy of Dermatology and Venereology*. 2015;**29**(6):1128–34.
- **82** Gisondi P, Cazzaniga S, Chimenti S, Maccarone M, Picardo M, Girolomoni G, et al. Latent tuberculosis infection in patients with chronic plaque psoriasis: evidence from the Italian Psocare Registry. *British Journal of Dermatology*. 2015;**172**(6):1613–20.

- 83 Papp K, Gottlieb AB, Naldi L, Pariser D, Ho V, Goyal K, et al. Experience with ustekinumab in patients with psoriasis enrolled in a large, multicenter, prospective, disease-based registry (Psoriasis Longitudinal Assessment and Registry (PSOLAR)).

 Journal of the American Academy of Dermatology. 2015; pii: S0190-9622(14)02102-1. doi: 10.1016/j. jaad.2014.10.025.
- **84** Augustin M, Glaeske G, Schafer I, Rustenbach SJ, Hoer A, Radtke MA. Processes of psoriasis health care in Germany long-term analysis of data from the statutory health insurances. *Journal of the German Society of Dermatology*. 2012;**10**(9):648–55.
- **85** Lebwohl MG, Bachelez H, Barker J, Girolomoni G, Kavanaugh A, Langley RG, et al. Patient perspectives in the management of psoriasis: results from the population-based Multinational Assessment of Psoriasis and Psoriatic Arthritis Survey. *Journal of the American Academy of Dermatology.* 2014;**70**(5): 871–81.
- **86** Armstrong AW, Robertson AD, Wu J, Schupp C, Lebwohl MG. Undertreatment, treatment trends, and treatment dissatisfaction among patients with psoriasis and psoriatic arthritis in the United States: findings from the National Psoriasis Foundation surveys, 2003–2011. *Journal of the American Medical Association Dermatology*. 2013;**149**(10):1180–5.
- **87** Ragnarson TG, Hjortsberg C, Bjarnason A, Gniadecki R, Heikkila H, Jemec GB, et al. Treatment patterns, treatment satisfaction, severity of disease problems, and quality of life in patients with psoriasis in three Nordic countries. *Acta Dermato-Venereologica*. 2013;**93**(4):442–5.
- **88** Garcia-Doval I, Rustenbach SJ, Stern R, Dam TN, Cohen AD, Baker C, et al. Systemic psoriasis therapy shows high between-country variation: a sign of unwarranted variation? Cross-sectional analysis of baseline data from the PSONET registries. *British Journal of Dermatology*. 2013;**169**(3):710–14.
- **89** Naldi L, Addis A, Chimenti S, Giannetti A, Picardo M, Tomino C, et al. Impact of body mass index and obesity on clinical response to systemic treatment for psoriasis. Evidence from the Psocare project. *Dermatology.* 2008;**217**(4):365–73.
- **90** Piaserico S, Cazzaniga S, Chimenti S, Giannetti A, Maccarone M, Picardo M, et al. Efficacy of switching between tumor necrosis factor-alfa inhibitors in psoriasis: results from the Italian Psocare registry.

- Journal of the American Academy of Dermatology. 2014;**70**(2):257–62.
- **91** Fonia A, Jackson K, Lereun C, Grant DM, Barker JN, Smith CH. A retrospective cohort study of the impact of biologic therapy initiation on medical resource use and costs in patients with moderate to severe psoriasis. *British Journal of Dermatology*. 2010;**163**(4):807–16.
- **92** Rustin MH. Long-term safety of biologics in the treatment of moderate-to-severe plaque psoriasis: review of current data. *British Journal of Dermatology*. 2012;**167**(Suppl. 3):3–11.
- 93 Menting SP, van Lumig PP, de Vries AC, van den Reek JM, van der KD, de Jong EM, et al. Extent and consequences of antibody formation against adalimumab in patients with psoriasis: one-year follow-up. *Journal of the American Medical Association Dermatology*. 2014;**150**(2):130–6.
- **94** Askling J, Fored CM, Brandt L, Baecklund E, Bertilsson L, Coster L, et al. Risk and case characteristics of tuberculosis in rheumatoid arthritis associated with tumor necrosis factor antagonists in Sweden. *Arthritis and Rheumatism.* 2005;**52**(7):1986–92.

- 1 International Agency for Research on Cancer. Globocan 2012: Estimated Cancer Incidence, Mortality and Prevalence Worldwide in 2012. Available from: http://globocan.iarc.fr/Pages/fact_sheets_population.aspx (last accessed 18 November 2015).
- **2** Ferlay J, Steliarova-Foucher E, Lortet-Tieulent J, Rosso S, Coebergh JW, Comber H, et al. Cancer incidence and mortality patterns in Europe: estimates for 40 countries in 2012. *European Journal of Cancer*. 2013;**49**(6):1374–403.
- 3 Eurostat AD. Causes of Death Standardised Death Rate (per 100 000 Inhabitants) 2013. Available from: http://epp.eurostat.ec.europa.eu/portal/page/portal/product_details/publication?p_product_code=KS-30-08-357 (last accessed 18 November 2015).
- **4** Vogel CL, Cobleigh MA, Tripathy D, Gutheil JC, Harris LN, Fehrenbacher L, et al. First-line Herceptin monotherapy in metastatic breast cancer use of chemotherapy plus a monoclonal antibody against HER2 for metastatic breast cancer that overexpresses HER2. *Oncology*. 2001;**61**(Suppl. 2):37–42.
- **5** Early Breast Cancer Trialists' Collaborative Group. Effects of chemotherapy and hormonal therapy for early breast cancer on recurrence and 15-year survival: an overview of the randomised trials. *Lancet*. 2005;**365**(9472):1687–717.
- **6** Hodi FS, O'Day SJ, McDermott DF, Weber RW, Sosman JA, Haanen JB, et al. Improved survival with ipilimumab in patients with metastatic melanoma. *New England Journal of Medicine*. 2010;**363**(8):711–23.
- 7 Animal Cell Technology Industrial Platform. Monoclonal Antibodies Approved by the EMA and FDA for Therapeutic Use (Status 2013). Available from:

- http://www.actip.org/products/monoclonal-antibodies-approved-by-the-ema-and-fda-for-therapeutic-use/ (last accessed 18 November 2015).
- 8 European Medicines Agency. Orphan Drug Designations 2015. Available from: http://www.ema.europa.eu/ema/index.jsp?curl=pages/medicines/human/orphans/2009/11/human_orphan_000468.jsp&mid=WC0b01ac058001d12b (last accessed 18 November 2015).
- **9** SMS-Oncology. EMA Anticancer Drug Approval in 2014. Available from: http://sms-oncology.com/blog/ema-anticancer-drug-approval-in-2014/ (last accessed 18 November 2015).
- 10 Niraula S, Seruga B, Ocana A, Shao T, Goldstein R, Tannock IF, et al. The price we pay for progress: a meta-analysis of harms of newly approved anticancer drugs. *Journal of Clinical Oncology*. 2012;30(24):3012–19.
- 11 National Cancer Institute. Targeted Cancer Therapies. Available from: http://www.cancer.gov/about-cancer/treatment/types/targeted-therapies/targeted-therapies-fact-sheet (last accessed 18 November 2015).
- 12 European Medicines Agency. Orphan Designation 2014. Available from: http://www.ema.europa.eu/ema/index.jsp?curl=pages/regulation/general/general_content_000029.jsp& (last accessed 18 November 2015).
- 13 Food and Drug Administration. Developing Products for Rare Diseases & Conditions. Available from: http://www.fda.gov/forindustry/DevelopingProductsforrareDiseasesConditions/default.htm (last accessed 18 November 2015).
- **14** Amir E, Seruga B, Kwong R, Tannock IF, Ocana A. Poor correlation between progression-free and overall survival in modern clinical trials: are composite endpoints the answer? *European Journal of Cancer.* 2012;**48**(3):385–8.

15 Shea MB, Roberts SA, Walrath JC, Allen JD, Sigal EV. Use of multiple endpoints and approval paths depicts a decade of FDA oncology drug approvals.

Clinical Cancer Research. 2013;19(14):3722-31.

- StatBite: Drugs in development by therapeutic area (2010). *Journal of the National Cancer Institute*. 2012;**104**(2):86.
- 17 Wilking N, Jönsson B, Högberg D, Justo N. Comparator Report on Patient Access to Cancer Drugs in Europe. Available from: http://www.interpharma.ch/sites/default/files/medikamente_zugang_zu_innovation_comparator_report_2009_0.pdf (last accessed 18 November 2015).
- 18 European Medicines Agency. EudraGMDP database. Available from: http://www.ema.europa.eu/ema/index.jsp?curl=pages/regulation/general/eudra_gmp_database.jsp&mid=WC0b01ac058006e06e (last accessed 18 November 2015).
- Luengo-Fernandez R, Leal J, Gray A, Sullivan R. Economic burden of cancer across the European Union: a population-based cost analysis. *Lancet Oncology*. 2013;**14**(12):1165–74.
- **20** Marsland T, Robbins G, Marks A, Cassell R, Philips DG, King K. Reducing cancer costs and improving quality through collaboration with payers: a proposal from the Florida society of clinical oncology. *Journal of Oncology Practice*. 2010;**6**(5):265–9.
- Jonsson B, Wilking N. A global comparison regarding patient access to cancer drugs. *Annals of Oncology*. 2007;**18**(Suppl. 3):iii1–iii77.
- Light DW, Kantarjian H. Market spiral pricing of cancer drugs. *Cancer*. 2013;**119**(22):3900–2.
- **23** Martell RE, Sermer D, Getz K, Kaitin KI. Oncology drug development and approval of systemic anticancer therapy by the US Food and Drug Administration. *Oncologist.* 2013;**18**(1):104–11.
- Siddiqui M, Rajkumar SV. The high cost of cancer drugs and what we can do about it. *Mayo Clinic Proceedings*. 2012;**87**(10):935–43.
- Amir E, Seruga B, Martinez-Lopez J, Kwong R, Pandiella A, Tannock IF, et al. Oncogenic targets, magnitude of benefit, and market pricing of antineoplastic drugs. *Journal of Clinical Oncology*. 2011;**29**(18):2543–9.
- Khayat D. Innovative cancer therapies putting costs into context. *Cancer.* 2012;**118**(9):2367–71.
- Jönsson B, Wilking, N. LIF Rapport: Läkemedelsutvecklingen inom cancerområdet. 2008:6. Rapport från

- LIF till Utredningen om en nationell cancerstrategi. Available from: http://www.forskasverige.se/wp-content/uploads/Lakemedelsutvecklingen-Inom-Canceromradet-LIF.pdf (last accessed 18 November 2015).
- Bergstrom R. Drivers of the cost of cancer care. *Lancet Oncology*. 2012;**13**(1):14–15.
- Olver I. Challenges of accessing cancer medicines in Australia. *Lancet Oncology*. 2013;**14**(11):1040–2.
- 30 Generics and Biosimilars Initiative. Pricing of Biosimilars. Available from: http://gabionline.net/Biosimilars/Research/Pricing-of-biosimilars(lastaccessed 18 November 2015).
- **31** Gascon P, Tesch H, Verpoort K, Rosati MS, Salesi N, Agrawal S, et al. Clinical experience with Zarzio® in Europe: what have we learned? *Supportive Care in Cancer.* 2013;**21**(10):2925–32.
- 32 PM-Live. Roche blocks Herceptin biosimilar in India. Available from: http://www.pmlive.com/pharma_news/roche_blocks_herceptin_biosimilar_in_india_542104 (last accessed 18 November 2015).
- Jönsson B, Wilking N. New cancer drugs in Sweden: assessment, implementation and access. *Journal of Cancer Policy*. 2014;**2**:45–62.
- Helsana. Medikamentenstatistik 2013: Onkologie. Available from: https://www.helsana.ch/docs/medikamentenstatistik-onkologie.pdf (last accessed 18 November 2015).
- Civan A, Koksal, B. The effect of newer drugs on health spending: do they really increase the costs? *Health Economics*. 2010;**19**(5):581–95.
- Hirsch BR, Califf RM, Cheng SK, Tasneem A, Horton J, Chiswell K, et al. Characteristics of oncology clinical trials: insights from a systematic analysis of ClinicalTrials.gov. *Journal of the American Medical Association Internal Medicine*. 2013;**173**(11):972–9.
- Parkinson B, Pearson SA, Viney R. Economic evaluations of trastuzumab in HER2-positive metastatic breast cancer: a systematic review and critique. *European Journal of Health Economics*. 2014;**15**(1):93–112.
- Adamski J, Godman B, Ofierska-Sujkowska G, Osińska B, Herholz H, Wendykowska K., et al. Risk sharing arrangements for pharmaceuticals: potential considerations and recommendations for European payers. *BMC Health Service Response*. 2010;**10**:153.
- Cheema PK, Gavura S, Migus M, Godman B, Yeung L, Trudeau ME. International variability in the reimbursement of cancer drugs by pub-

- lically funded drug programs. *Current Oncology*. 2012;**19**(3):165–76.
- 40 Espin J, Rovira J, Garcia L. Experiences and Impact of European Risk-Sharing Schemes Focusing on Oncology Medicines. Available from: http://www. researchgate.net/publication/260343816_Experiences_and_Impact_of_European_Risk-Sharing_ Schemes_Focusing_on_Oncology_Medicines (last accessed 18 November 2015).
- **41** Williamson S. Patient access schemes for high-cost cancer medicines. *Lancet Oncology*. 2010;**11**(2): 111–12.
- **42** Vitry AI, Thai LP, Lu CY. Time and geographical variations in utilization of endocrine therapy for breast cancer in Australia. *Internal Medicine Journal*. 2011;**41**(2):162–6.
- **43** Chang CS, Yang YH, Hsu CN, Lin MT. Trends in the treatment changes and medication persistence of chronic myeloid leukemia in Taiwan from 1997 to 2007: a longitudinal population database analysis. *BMC Health Service Research*. 2012;**12**:359.
- **44** Wang Z, Askamit I, Tuscher L, Bergstrom K. Rates of guideline adherence among US community oncologists treating NSCLC. *American Journal of Managed Care*. 2013;**19**(3):185–92.
- **45** Wilking N, Jönsson B, Högberg D, Justo N. *Comparator Report on Patient Access to Cancer Drugs in Europe.*Stockholm, Karolinska Institutet and Stockholm School of Economics, 2009.
- **46** Richards MA. Extent and Causes of International Variations in Drug Usage. Available from: https://www.gov.uk/government/publications/extent-and-causes-of-international-variations-in-drug-usage (last accessed 18 November 2015).
- 47 Opticon. Skillnader i användning av innovativa läkemedel: en internationell jämförande studie på uppdrag av LIF. Available from: http://www.lif.se/globalassets/pdf/rapporter-externa/skillnader-i-anvandning-av-innovativa-lakemedel.pdf.pdf (last accessed 18 November 2015).
- **48** Ruddy K, Mayer E, Partridge A. Patient adherence and persistence with oral anticancer treatment. *CA: A Cancer Journal for Clinicians*. 2009;**59**(1):56–66.
- **49** Nekhlyudov L, Li L, Ross-Degnan D, Wagner AK. Five-year patterns of adjuvant hormonal therapy use, persistence, and adherence among insured women with early-stage breast cancer. *Breast Cancer Research and Treatment*. 2011;**130**(2):681–9.

- 50 van Herk-Sukel MP, van de Poll-Franse LV, Voogd AC, Nieuwenhuijzen GA, Coebergh JW, Herings RM. Half of breast cancer patients discontinue tamoxifen and any endocrine treatment before the end of the recommended treatment period of 5 years: a population-based analysis. *Breast Cancer Research and Treatment*. 2010;122(3):843–51.
- **51** Dusetzina SB, Winn AN, Abel GA, Huskamp HA, Keating NL. Cost sharing and adherence to tyrosine kinase inhibitors for patients with chronic myeloid leukemia. *Journal of Clinical Oncology*. 2014;**32**(4):306–11.
- **52** Zafar SY, Peppercorn JM, Schrag D, Taylor DH, Goetzinger AM, Zhong X, et al. The financial toxicity of cancer treatment: a pilot study assessing out-of-pocket expenses and the insured cancer patient's experience. *Oncologist*. 2013;**18**(4):381–90.
- **53** Peter A, Ubel P. Doctor, first tell me what it costs. *New York Times*. 3 November 2013. Available from: http://www.nytimes.com/2013/11/04/opinion/doctor-first-tell-me-what-it-costs.html?_r=3& (last accessed 18 November 2015).
- **54** Ramsey S, Blough D, Kirchhoff A, Kreizenbeck K, Fedorenko C, Snell K, et al. Washington State cancer patients found to be at greater risk for bankruptcy than people without a cancer diagnosis. *Health Affairs*. 2013;**32**(6):1143–52.
- 55 Lu CY, Srasuebkul P, Drew AK, Chen K, Ward RL, Pearson SA. Trastuzumab therapy in Australia: which patients with HER2+ metastatic breast cancer are assessed for cardiac function? *Breast*. 2013;22(4):482–7.
- 56 Wettermark B, Zoega H, Furu K, Korhonen M, Hallas J, Norgaard M, et al. The Nordic prescription databases as a resource for pharmacoepidemiological research a literature review. *Pharmacoepidemiology & Drug Safety.* 2013;22(7):691–9.
- **57** van Herk-Sukel M, Lemmens V, van de Poll-Franse L, Herings R, Coebrgh J. Record linkage for pharmacoepidemiological studies in cancer patients. *Pharmacoepidemiology & Drug Safety*. 2012;**21**:94−103.
- **58** Soon SS, Lim HY, Lopes G, Ahn J, Hu M, Ibrahim HM, et al. Roles of cancer registries in enhancing oncology drug access in the Asia-Pacific region. *Asian Pacific Journal of Cancer Prevention*. 2013;**14**(4):2159–65.
- **59** Lee SJ, Earle CC, Weeks JC. Outcomes research in oncology: history, conceptual framework, and

- trends in the literature. *Journal of the National Cancer Institute*. 2000;**92**(3):195–204.
- 60 Franken MG, Gaultney JG, Blommestein HM, Huijgens PC, Sonneveld P, Redekop WK, et al. Policymaker, please consider your needs carefully: does outcomes research in relapsed or refractory multiple myeloma reduce policymaker uncertainty regarding value for money of bortezomib? *Value in Health*. 2014;17(2):245–53.
- **61** ASCO. CancerLinQ, Building a Transformation in Cancer Care. Available from: http://www.asco.org/quality-guidelines/cancerlinq (last accessed 18 November 2015).
- **62** National Cacner Intelligence Network. National Cancer Data Repository. Available from: http://www.ncin.org. uk/collecting_and_using_data/national_cancer_data_repository/ (last accessed 18 November 2015).
- **63** Khayat D. Innovative cancer therapies: putting costs into context. *Cancer*. 2012;**118**(9):2367–71.
- **64** Wilking N, Jönsson B. A Pan-European Comparison Regarding Patient Access to Cancer Drugs.

- Available from: http://www.med.mcgill.ca/epidemiology/courses/EPIB654/Summer2010/Policy/Cancer_Report%20Karolinska.pdf (last accessed 18 November 2015).
- **65** Hofmarcher T, Jönsson B, Wilking N. Access to High-Quality Oncology Care across Europe. Available from: http://www.ihe.se/access-to-high-quality. aspx (last accessed 18 November 2015).
- 66 International Society for Pharmacoeconomics and Outcomes Research. France – Pharmaceuticals. Available from: http://www.ispor.org/htaroadmaps/ france.asp (last accessed 18 November 2015).
- **67** Wilking U, Jonsson B, Wilking N, Bergh J. Trastuzumab use in breast cancer patients in the six Health Care Regions in Sweden. *Acta Oncologica*. 2010;**49**(6):844–50.
- **68** Pearson SA, Ringland CL, Ward RL. Trastuzumab and metastatic breast cancer: trastuzumab use in Australia monitoring the effect of an expensive medicine access program. *Journal of Clinical Oncology*. 2007;**25**(24):3688–93.

- 1 Bigdeli M, Jacobs B, Tomson G, Laing R, Ghaffar A, Dujardin B, Van Damme W. Access to medicines from a health systems perspective. *Health Policy and Planning*. 2013;**28**:692–704.
- **2** UN Millennium Development Goals 8E. Available from: http://www.un.org/millenniumgoals/ (last accessed 18 November 2015).
- **3** World Health Organization. Available from: http://www.who.int/mediacentre/news/statements/2009/access-medicines-20090313/en/ (last accessed 18 November 2015).
- **4** Frost L, Reich M. Access: How Do Good Health Technologies Get to Poor People in Poor Countries? Cambridge, MA, Harvard University Press, 2008.
- **5** World Health Organization. Available from: http://www.who.int/mediacentre/factsheets/2003/fs275/en/ (last accessed 18 November 2015).
- **6** Malmstrom R, Godman B, Diogene E et al. Dabigatran a case history demonstrating the need for comprehensive approaches to optimise the use of new drugs in the future. *Frontiers in Pharmacology*. 2013:**4**:1–19.
- 7 Taylor L. Australian govt blocks subsidies for new drugs. *PharmaTimes*. 15 March 2011. Available from: http://www.pharmatimes.com/Article/11-03-15/Australian_govt_blocks_subsidies_for_new_drugs. aspx (last accessed 18 November 2015).
- 8 EvaluatePharma. Surveying Tomorrow's BioPharma Landscape: The NASDAQ Biotech Index Up Close. Available from: http://info.evaluatepharma.com/rs/evaluatepharmaltd/images/EvaluatePharma_NBI_Up_Close_2012.pdf (last accessed 18 November 2015).
- **9** Cameron A, Ewen M, Ross-Degnan D, Ball D, Laing R. Medicine prices, availability, and affordability in 36 developing and middle-income countries: a secondary analysis. *Lancet*. 2009;**373**(9659):240–9.

- 10 World Health Organization. Essential Medicines and Health Products. Available from: http://www.who.int/medicines/services/essmedicines_def/en/ (last accessed 18 November 2015).
- 11 Organisation for Economic Co-operation and Development. Health at a Glance 2013: OECD Indicators. Available from: http://www.oecd.org/els/health-systems/Health-at-a-Glance-2013.pdf (last accessed 18 November 2015).
- **12** Mao W, Tang S, Chen W. Does perverse economic incentive lead to the irrational use of medicines? *Expert Review of Pharmacoeconomics & Outcomes Research.* 2013;**13**(6):693–6.
- **13** Putrik P, Ramiro S, Kvien TK, Sokka T, Pavlova M, Uhlig T, et al. Inequities in access to biologic and synthetic DMARDs across 46 European countries. *Annals of Rheumatic Disease*. 2014;**73**:198–206.
- **14** Goldman DP, Joyce GF, Zheng Y. Prescription drug cost sharing. *Journal of the American Medical Association*. 2007;**298**(1):61–9.
- 15 Gustafsson LL, Wettermark B, Godman B, Andersén-Karlsson E, Bergman U, et al. The 'Wise List' a comprehensive concept to select, communicate and achieve adherence to recommendations of essential drugs in ambulatory care in Stockholm. Basic & Clinical Pharmacology & Toxicology. 2011;108:224–33.
- **16** Jappy B, Krska J, Downie GA, Smith ME, Williams A, Petrie JC. The Grampian Hospitals Drug Formulary. *Health Bulletin*. 1989;**47**:223–6.
- 17 Garvey G, Jappy B, Stewart D, Williams A, Duffus PR, Maitland JM, et al. Grampian Health Board's joint drug formulary. *British Medical Journal*. 1990;301:851–2.
- **18** Stewart DC, Milne K, Krska J, Downie G. Adherence to the Grampian joint drug formulary in general practice. *Journal of Clinical Pharmacy and Therapeutics*. 1996;**21**:79–82.

- **19** Godman B, Campbell S, Suh HS, Finlayson A, Bennie M, Gustafsson L. Ongoing measures to enhance prescribing efficiency across Europe: implications for other countries. *Journal of Health Technology Assessment*. 2013;**1**:27–42.
- 20 Godman B, Wettermark B, van Woerkom M, Fraeyman J, Alvarez-Madrazo S, Berg C, et al. Multiple policies to enhance prescribing efficiency for established medicines in Europe with a particular focus on demand-side measures: findings and future implications. *Frontiers in Pharmacology*. 2014;5:106.
- **21** Dylst P, Vulto A, Godman B, Simoens S. Generic medicines: solutions for a sustainable drug market? *Applied Health Economics and Health Policy*. 2013;**11**(5):437–43.
- **22** World Health Organization. *Drug and Therapeutic Committees, A Practical Approach*. Geneva, World Health Organization, 2003.
- 23 Bjorkhem-Bergman L, Andersen-Karlsson E, Laing R, Diogene E, Melien O, Jirlow M, et al. Interface management of pharmacotherapy. Joint hospital and primary care drug recommendations. *European Journal of Clinical Pharmacology*. 2013;**69**(Suppl. 1):73–8.
- **24** Torgesen I. Access to some NICE approved drugs varies hugely across England. *British Medical Journal*. 2014;**348**:g465.
- 25 World Bank. 2013 World Development Indicators. Available from: http://databank.worldbank.org/data/download/WDI-2013-ebook.pdf (last accessed 18 November 2015).
- **26** Filion KB, Delaney CJ A, Brophy JM, Ernst P, Suissa S. The impact of over-the-counter simvastatin on the number of statin prescriptions in the United Kingdom: a view from the General Practice Research Database. *Pharmacoepidemiology & Drug Safety.* 2007;**16:**1−4.
- 27 World Health Organization. Essential Medicines and Health Products Information Portal: A World Health Organization Resource. WHO Drug Information Vol. 15, No. 3 & 4, 2001. Last accessed: http://apps.who.int/medicinedocs/en/d/Jh2989e/ (18 November 2015).
- **28** Laing BA, Mackey TK. Prevalence and global health implications of social media in direct-to-consumer drug advertising. *Journal of Medical Internet Research*. 2011;**13**(3):e64.
- **29** McNaughton R, Huet G, Shakir S. An investigation into drug products withdrawn from the EU market

- between 2002 and 2011 for safety reasons and the evidence used to support the decision-making. *British Medical Journal Open.* 2014;**4**(1):e004221.
- **30** Merck. Merck Announces Voluntary Worldwide Withdrawal of VIOXX®. 30 September 2004. Available from: http://www.pbm.va.gov/vacenterformedicationsafety/vioxx/DearHealthcareProfessional.pdf (last accessed 18 November 2015).
- **31** Davies N, Jamali F. Cox-2 selective inhibitors cardiac toxicity: getting to the heart of the matter. *Journal of Pharmacy & Pharmaceutical Science*. 2004;**7**:332–6.
- **32** Bresalier R, Sandler R, Quan H, Bolognese JA, Oxenius B, Horgan K, et al. Cardiovascular events associated with rofecoxib in a colorectal adenoma chemoprevention trial. *New England Journal of Medicine*. 2005;**352**(11):1092–102.
- **33** Weir MR, Sperling RS, Reicin A, Gertz BJ. Selective COX-2 inhibition and cardiovascular effects: a review of the rofecoxib development program. *American Heart Journal*. 2003;**146**:591–604.
- **34** Bombardier L, Laine L, Reicin A, Shapiro D, Burgos-Vargas R, Davis B, et al. Comparison of upper gastrointestinal toxicity of rofecoxib and naproxen in patients with rheumatoid arthritis. *New England Journal of Medicine*. 2000;**343**:1520–8.
- 35 Food and Drug Administration. Vioxx (Rofecoxib) May 2002. Available from: http://www.fda.gov/Safety/MedWatch/SafetyInformation/SafetyAlertsforHumanMedicalProducts/ucm154520.htm (last accessed 18 November 2015).
- **36** Calfee JE, Pinell X. Prepared for a conference on consumers, information, and the evolving healthcare market place. Available from: http://www.aei.org/papers/health/the-significance-of-the-vioxx-withdrawal/ (last accessed 18 November 2015).
- **37** Quick JD, Hogerzeil HV, Velasquez G, Rago L. Twenty-five years of essential medicines. *Bulletin of the World Health Organization*. 2002;**80**(11):913–14.
- 38 World Health Organization. Surge in demand leads to shortage of artemisinin-based combination therapy for malaria. Available from: http://www.who.int/mediacentre/news/releases/2004/pr77/en/ (last accessed 18 November 2015).
- 39 Neuman J, Korenstein D, Ross JS, Keyhani S. Prevalence of financial conflicts of interest among panel members producing clinical practice guidelines in Canada and United States: cross sectional study. British Medical Journal. 2011;343:d5621.

- **40** AGREE Research Trust. Appraisal of Guidelines for Research and Evaluation II. Available from: http://www.agreetrust.org/wp-content/uploads/2013/10/AGREE-II-Users-Manual-and-23-item-Instrument_2009_UPDATE_2013.pdf (last accessed 18 November 2015).
- **41** Cohen-Kohler JC. The morally uncomfortable drug gap. *Clinical Pharmacology and Therapeutics*. 2007;**82**(5):610–14.
- **42** Busfield J. 'A pill for every ill': explaining the expansion in medicine use. *Social Science Medicine*. 2010;**70**:934–41.
- **43** Vernaz N, Haller G, Girardin F, Huttner B, Combescure C, Dayer P, et al. Patented drug extension strategies on healthcare spending: a cost-evaluation analysis. *PLoS Medicine*. 2013;**10**(6):e1001460.
- **44** Light DW, Lexchin J, Darrow JJ. Institutional corruption of pharmaceuticals and the myth of safe and effective drugs. *Journal of Law, Medicine & Ethics*. 2013;**41**(3):590–600.

- 1 Sketris I, Ingram EL, Lummis H. Optimal Prescribing and Medication Usein Canada: Challenges and Opportunities. Last accessed: http://healthcouncilcanada.ca/tree/2.37.1-Appendices_Optimizing PrescribingBehaviours.pdf (18 November 2015).
- **2** Denig P, Haaijer-Ruskamp FM, Zijsling DH. How physicians choose drugs. *Social Science & Medicine*. 1988;**27**(12):1381–6.
- 3 Haaijer-Ruskamp FM, Hemminki E. *The Social Aspects of Drug Use. Dukes MNG. Drug Utilization Studies: Methods and Uses.* Finland, WHO Regional Publications, 1993.
- **4** Wirtz V, Cribb A, Barber N. Patient-doctor decision-making about treatment within the consultation a critical analysis of models. *Social Science & Medicine*. 2006;**62**(1):116–24.
- **5** De Vries TPGM, Henning RH, Hogerzeil HV, Fresle DA. *Guide to Good Prescribing*. Geneva, World Health Organization, 1995. Available from: http://apps. who.int/medicinedocs/pdf/whozip23e/whozip23e. pdf (last accessed 18 November 2015).
- **6** Maxwell S, Walley T. Teaching safe and effective prescribing in UK medical schools: a core curriculum for tomorrow's doctors. *British Journal of Clinical Pharmacology*. 2003;**55**:496–503.
- **7** Sjoqvist F, Orme M. Clinical pharmacology in research, teaching and health care. *Basic & Clinical Pharmacology & Toxicology*. 2010;**107**:531–59.
- **8** World Health Organization. Medicines: Country Situational Analysis. Available from: http://www.searo. who.int/entity/medicines/country_situational_analysis/en/ (last accessed 18 November 2015).
- **9** Latter S, Blenkinsopp A, Smith A, Chapman S, Tinelli M, Gerard K, Dorer G. Evaluation of nurse and pharmacist independent prescribing. University of Southampton & Keele University. Available

- from: http://eprints.soton.ac.uk/184777/3/ENPIP fullreport.pdf (last accessed 18 November 2015).
- 10 Kroezen M, van Dijk L, Groenewegen PP, Francke AL. Nurse prescribing of medicines in Western European and Anglo-Saxon countries: a systematic review of the literature. BMC Health Services Research. 2011;11:127.
- 11 Bhanbhro S, Drennan VM, Grant R, Harris R. Assessing the contribution of prescribing in primary care by nurses and professionals allied to medicine: a systematic review of literature. *BMC Health Services Research*. 2011;11:330.
- 12 Holloway KA, Ivanovska I, Wagner AK, Vialle-Valentin C, Ross-Degnan R. Have we improved use of medicines in developing countries and do we know how to? Two decades of evidence. *Tropical Medicine and International Health*. 2013;18(6):656–64.
- 13 Holloway KA, Ivanovska I, Wagner AK, Vialle-Valentin C, Ross-Degnan R. Prescribing for acute childhood infections in developing and transitional countries, 1990–2009. *Paediatrics and International Child Health*. 2015;35(1):5–13.
- **14** Denig P, Haaijer-Ruskamp FM. Therapeutic decision making of physicians. *Pharmaceutisch Weekblad*. 1992;**14**:9–15.
- 15 Bissessur SW, Geijteman EC, Al-Dulaimy M, Teunissen PW, Richir MC, Arnold AE, de Vries TP. Therapeutic reasoning: from hiatus to hypothetical model. *Journal of Evaluation in Clinical Practice*. 2009;15:985–9.
- **16** Figueras A. The use of drugs is not as rational as we believe... but it can't be! The emotional roots of prescribing. *European Journal of Clinical Pharmacology*. 2011;**67**:433–5.
- 17 Hafler JP, Ownby AR, Thompson BM, Fasser CE, Grigsby K, Haidet P, et al. Decoding the learning environment of medical education: a hidden curric-

- ulum perspective for faculty development. *Academic Medicine*. 2011:**86**:440–4.
- 18 National Institute for Health and Care Excellence. Lipid modification: cardiovascular risk assessment and the modification of blood lipids for the primary and secondary prevention of cardiovascular disease. NICE Guidelines CG67. Available from: https://www.nice.org.uk/guidance/cg67 (18 November 2015).
- **19** Sackett D Rosenberg WMC, Gray JAM, Haynes RB, Richardson WS. Evidence based medicine: what it is and what it isn't. *British Medical Journal*. 1996;**312**:71.
- **20** Carthy P, Harvey I, Brawn R, Watkins C. A study of factors associated with cost and variation in prescribing among GPs. *Family Practice*. 2000;**17**:36–41.
- 21 Eiermann B, Bastholm-Rahmner P, Korkmaz S, Lilja B, Veg A, Wettermark B, Gustafsson LL. Knowledge databases for clinical decision support in drug prescribing development, quality assurance, management, integration, implementation and evaluation of clinical value. In: Jao CS, ed. *Decision Support Systems*. Vienna, InTech, 2010.
- **22** Schedlbauer A, Prasad V, Mulvaney C, Phansalkar S, Stanton W, Bates DW, Avery AJ. What evidence supports the use of computerized alerts and prompts to improve clinicians' prescribing behaviour? *Journal of the American Medical Information Association*. 2009;**16**(4):531–8.
- 23 Avery A, Barber N, Ghaleb M, Franklin BD, Armstrong S, Crowe S, et al. Investigating the Prevalence and Causes of Prescribing Errors in General Practice: The PRACtICe Study. Available from: http://docplayer.net/406579-Investigating-the-prevalence-and-causes-of-prescribing-errors-in-general-practice-the-practice-study-a-report-for-the-gmc.html (18 November 2015).
- **24** Black AD, Car J, Pagilari C, Anandan C, Cresswell Kokun T, et al. The impact of ehealth on the quality and safety of health care: a systematic overview. *PLoS Medicine*. 2011;**8**(1):e1000387.
- **25** De Smet PAGM, Dautzenberg M. Repeat prescribing. *Drugs*. 2004;**64**:1779–800.
- **26** Petty DR, Zermansky AG, Alldred DP. The scale of repeat prescribing-time for an update. *BMC Health Services Research.* 2014;**14**:76.
- **27** Zermansky AG. Who controls repeat prescribing? *British Journal of General Practice*. 1996;**46**:643–7.

- **28** Coleman R, Gill G, Wilkinson D. Noncommunicable disease management in resource-poor settings: a primary care model from rural South Africa. *Bulletin of the World Health Organization*. 1998;**76**(6):633.
- **29** Lewis PJ, Tully MP. The discomfort caused by patient pressure on the prescribing decisions of hospital prescribers. *Research in Social & Administrative Pharmacy.* 2011;**7**:4–15.
- **30** Huttner, B, Goossens H, Verheij T, Harbarth S. Characteristics and outcomes of public campaigns aimed at improving the use of antibiotics in outpatients in high-income countries. *Lancet Infectious Diseases*. 2010;**10**:17–31.
- **31** Pound P, Britten N, Morgan M, Yardley, L, Pope C, Daker-White G, Campbell R. Resisting medicines: a synthesis of qualitative studies of medicine taking. *Social Science & Medicine*. 2005;**61**(1):133–55.
- **32** Britten N, Stevenson FA, Barry CA, Barber N, Bradley CP. Misunderstandings in prescribing decisions in general practice: qualitative study. *British Medical Journal*. 2000;**320**:484–8.
- **33** Hadiyono JEP, Suryawati S, Danu SS, Sunartono, Santoso B. Interactional group discussion: results of a controlled trial using a behavioural intervention to reduce the use of injections in public health facilities. *Social Science and Medicine*. 1996;**42**(8):1177–83.
- **34** Bond C, Blenkinsopp A, Raynor D. Prescribing and partnership with patients. *British Journal of Clinical Pharmacology*. 2012;**74**:581–8.
- **35** National Voices. *Supporting Shared Decision-Making: Summarising Evidence from Systematic Reviews.* London, The Evidence Centre for National Voices, 2014.
- 36 Teixeira Rodrigues A, Roque F, Falcão A, Figuerias A, Herdeiro MT. Understanding physician antibiotic prescribing behaviour: a systematic review of qualitative studies. *International Journal of Antimicrobial Agents*. 2013;41:203–12.
- 37 Brookes-Howell L, Hood K, Cooper L, Little P, Verheij T, Coenen S, et al. Understanding variation in primary medical care: a nine-country qualitative study of clinicians' accounts of the non-clinical factors that shape antibiotic prescribing decisions for lower respiratory tract infection. *British Medical Journal Open.* 2012;2(4):e000796.
- **38** Jones MI, Greenfield SM, Bradley CP. Prescribing new drugs: qualitative study of influences on consultants and general practitioners. *British Medical Journal*. 2001;**323**(7309):378–81.

- **39** Flodgren G, Parmelli E, Doumit G, Gattellari M, O'Brien MA, Grimshaw J, Eccles MP. Local opinion leaders: effects on professional practice and health care outcomes. *Cochrane Database of Systematic Reviews*. **2011:8**:CD000125.
- **40** de Bakker DH, Coffie DS, Heerdink ER, van Dijk L, Groenewegen PP. Determinants of the range of drugs prescribed in general practice: a cross-sectional analysis. *BMC Health Services Research*. 2007:**7**:132.
- 41 PEW Charitable Trusts. Persuading the Prescribers: Pharmaceutical Industry Marketing and its Influence on Physicians and Patients. Available from: http://www.pewhealth.org/other-resource/persuading-the-prescribers-pharmaceutical-industry-marketing-and-its-influence-on-physicians-and-patients-85899439814 (last accessed 18 November 2015).
- **42** Spurling GK, Mansfield PR, Montgomery BD, Lexchin J, Doust J, Othman N, Vitry AI. Information from pharmaceutical companies and the quality, quantity, and cost of physicians' prescribing: a systematic review. *PLoS Medicine*. 2010;**7**(10):e1000352.
- 43 Norris P, Herxheimer A, Lexchin J, Mansfield P. Drug Promotion: What We Know, What We Have Yet To Learn. Reviews of Materials in the WHO/ HAI Database on Drug Promotion. Available from: http://apps.who.int/medicinedocs/pdf/s8109e/s8109e.pdf (last accessed 18 November 2015).
- **44** Khakhkhar T, Mehta M, Shah R, Sharma D. Evaluation of drug promotional literatures using WHO guidelines. *Journal of Pharmaceutical Negative Results*. 2013;**4**:33–8.
- 45 Ethical Standards in Health & Life Sciences Group. Guidance on Collaboration between Healthcare Professionals and the Pharmaceutical Industry. Available from: https://www.rcpsych.ac.uk/pdf/Guidance%20on%20collaboration%20between%20healthcare%20professionals%20and%20the%20pharmaceutical%20industry.pdf (last accessed 18 November 2015).
- **46** Greenhalgh T. No such thing as a free lunch. *British Journal of General Practice*. 2012;**62**(604):594.
- 47 World Health Organization, Health Action International. Understanding and Responding to Pharmaceutical Promotion: A Practical Guide. Available from: http://www.researchgate.net/publication/264893905_Understanding_and_

- Responding_to_Pharmaceutical_Promotion_A_ practical_guide (last accessed 18 November 2015).
- **48** Adamski J, Godman B, Ofierska-Sujkowska G, Osińska B, Herholz H, Wendykowska K, et al. Risk sharing arrangements for pharmaceuticals: potential considerations and recommendations for European payers. *BMC Health Services Research*. 2010;**10**:153.
- **49** Australian Government Pharmaceutical Benefits Scheme website: www.pbs.gov.au.
- **50** Commonwealth Department of Health and Aged Care, 1998–2001.
- 51 NPS Medicinewise website: www.nps.org.au.
- **52** Sabuncu E, David J, Bernède-Bauduin C, Pépin S, Leroy M, Boëlle PY, et al. Significant reduction of antibiotic use in the community after a nationwide campaign in France, 2002–2007. *PLoS Medicine*. 2009;**6**(6):e1000084.
- **53** Trap B, Hansen EH, Hogerzeil HV. Prescription habits of dispensing and non-dispensing doctors in Zimbabwe. *Health Policy and Planning*. 2002;**17**(3):288–95.
- **54** Kaiser B, Schmidt C. Does physician dispensing increase drug expenditure? Empirical evidence from Switzerland. *Health Economics*. 2014; doi: 10.1002/hec.3124.
- 55 World Health Organization. Using Indicators to Measure Country Pharmaceutical Situations: Fact Book on WHO Level I and Level II Monitoring Indicators. Available from: http://www.who.int/medicines/publications/WHOTCM2006.2A.pdf (last accessed 18 November 2015).
- 56 World Health Organization. Country Pharmaceutical Situations: Fact Book on WHO Level 1 Indicators. Available from: http://apps.who.int/medicinedocs/en/d/Js16874e/ (last accessed 18 November 2015).
- **57** Holloway KA. Combating inappropriate use of medicines. *Expert Reviews in Clinical Pharmacology*. 2011;**4**(3):335–48.
- 58 World Health Organization. Medicines Use in Primary Care in Developing and Transitional Countries: Fact Book Summarizing Results from Studies Reported between 1990 and 2006. Available from: http://www.who.int/medicines/publications/primary_care_8April09.pdf?ua=1 (last accessed 18 November 2015).
- **59** World Health Organization. The World Medicines Situation 2011, 3rd edn. Rational Use of Medicines.

- Available from: http://www.who.int/medicines/ areas/policy/world_medicines_situation/en/index. html (last accessed 18 November 2015).
- 60 Holloway KA, Gautam BR, Harpham T, Taket A. Influence of user fees and patient demand on prescribers in rural Nepal. Social Science and Medicine. 2002;54(6):905-18.
- **61** World Health Organization. Country Pharmaceutical Profiles. Available from: http://www.who.int/medi-
- cines/areas/coordination/coordination_assessment/ en/ (last accessed 18 November 2015).
- 62 World Health Organization. Effective Management of Medicines: Report of the South-East Asia Regional Consultation, Bangkok, Thailand, 23-26 April 2013. Available from: http://www.searo. who.int/entity/medicines/documents/reort_ regional_consultation_effective_management_of_ medicines/en/ (last accessed 18 November 2015).

- 1 Hardon A, Hodgkin C, Fresle D. *How to Investigate the Use of Medicines by Consumers*. World Health Organization and University of Amsterdam, 2004.
- **2** Björnsdottir I, Almarsdottir AB, Traulsen JM. The lay public's explicit and implicit definitions of drugs. *Research in Social and Administrative Pharmacy*. 2009;**5**:40–50.
- **3** Ernst E. The role of complementary and alternative medicine. *British Medical Journal*. 2000;**321**:1133.
- **4** Lock M, Nguyen V-K. *An Anthropology of Biomedicine*. Chichester, John Wiley & Sons, 2010.
- **5** Bissell P, Traulsen JM. *Sociology and Pharmacy Practice*. London, Pharmaceutical Press, 2005.
- **6** Lynch N, Berry D. Differences in perceived risks and benefits of herbal, over-the-counter conventional, and prescribed conventional, medicines, and the implications of this for the safe and effective use of herbal products. *Complementary Therapies in Medicine*. 2007;**15**:84–91.
- **7** Møldrup C, Morgall JM. Risks of future drugs: a Danish expert Delphi. *Technological Forecasting and Social Change*. 2001;**67**:273–89.
- **8** Douglas M, Wildavsky A. *Risk and Culture*. Berkeley, CA, University of California Press, 1982.
- **9** Street RL, Haidet P. How well do doctors know their patients? Factors affecting doctors understanding of patients health beliefs. *Journal of General Internal Medicine*. 2010;**26**:21–7.
- **10** Dowell J, Williams B, Snadden D. *Patient-Centred Prescribing: Seeking Concordance in Practice*. Oxford, Radcliffe Publishing, 2007.
- **11** Chewning B, Bylund CL, Shah B, Arora NK, Gueguen JA, Makoul G. Patient preferences for shared decisions: a systematic review. *Patient Education and Counseling*. 2012;**86**:9–18.

- **12** Bagge M, Norris P, Heydon S, Tordoff J. Older people's experiences of medicine changes on leaving hospital. *Research in Social & Administrative Pharmacy*.2014;**10**(5):791–800.
- **13** Volume C, Burback L, Farris K. Reassessing the MAI: elderly people's opinions about medication appropriateness. *International Journal of Pharmacy Practice*. 1999;**7**:129–37.
- 14 Nørreslet M, Bissell P, Traulsen JM. From consumerism to active dependence: patterns of medicines use and treatment decisions among patients with atopic dermatitis. *Health*. 2010;14(1):91–106.
- **15** Traulsen JM, Almarsdóttir AB, Björnsdóttir I. The lay user perspective on the quality of pharmaceuticals, drug therapy and pharmacy services. *Pharmacy World and Science*. 2002;**24**(5):196–200.
- **16** Britten N, Jenkins L, Barber N, Bradley C, Stevenson F. Developing a measure for the appropriateness of prescribing in general practice. *Quality & Safety in Health Care.* 2003:**12**:246−50.
- 17 Cribb A, Barber N. Prescribers, patients and policy: the limits of technique. *Health Care Analysis*. 1997;**5**:292–8.
- 18 Duerden M, Avery T, Payne R. Polypharmacy and Medicines Optimisation. Available from: http://www.kingsfund.org.uk/sites/files/kf/field/field_publication_file/polypharmacy-and-medicinesoptimisation-kingsfund-nov13.pdf (last accessed 18 November 2015).
- **19** Isacson D, Bingefors K. Attitudes towards drugs a survey in the general population, *Pharmacy World & Science*. 2002;**24**:104–10.
- **20** Britten N, Ukoumunne O, Boulton M. Patients' attitudes to medicines and expectations for prescriptions. *Health Expectations*. 2002;**5**:256–69.
- 21 Moen AC, Bohma A, Tillenius T, Antonov B, Nilsson JLG, Ring L. 'I don't know how many of these [medicines] are necessary': a focus group study

- among elderly users of multiple medicines. *Patient Education and Counseling*, 2009;**74**:135–41.
- **22** Tordoff JM, Bagge ML, Gray AR, Campbell AJ, Norris PT. Medicine-taking practices in community-dwelling people aged > or =75 years in New Zealand. *Age & Ageing*. 2010;**39**(5):574–80.
- **23** Grime J, Pollock K. Patients' ambivalence about taking antidepressants: a qualitative study. *Pharmaceutical Journal*. 2003:**271**:516–19.
- 24 World Health Organization. The Role of the Pharmacist in Self-Care and Self-Medication. Available from: http://apps.who.int/medicinedocs/en/d/ Jwhozip32e/2.html (last accessed 18 November 2015).
- **25** MacKichan F, Paterson C, Henley WE, Britten N. Self-care in people with long term health problems: a community based survey. *BMC Family Practice*. 2011:**12**:53.
- 26 Nuffield Council on Bioethics. Medical Profiling and Online Medicine: The Ethics of 'Personalised Healthcare' in a Consumer Age. Chapter 7: Online purchasing of pharmaceuticals. London, Nuffield Council on Bioethics, 2010.
- **27** Sihvo S, Ahonen R, Mikander H, Hemminki E. Self-medication with vaginal antifungal drugs: physicians' experiences and women's utilization patterns. *Family Practice*. 2000;**17**:145–9.
- **28** Ruiz MA. Risks of self-medication practices. *Current Drug Safety*. 2010;**5**:315–23.
- **29** Petersen MA, Laing E, Traulsen JM. What are university students' views on the self-prescribing of 'smart drugs'? *Pharmacy Journal*. 2013;**290**:207.
- **30** Kesselheim AS, Misono AS, Shrank WH, Greene JA, Doherty M, Avorn J, Choudhry NK. Variations in pill appearance of antiepileptic drugs and the risk of nonadherence. *Journal of the American Medical Association Internal Medicine*. 2013;**173**(3): 202–8.
- **31** Hassali MA, Shafie AA, Jamshed A, Ibrahim M, Awaisu A. Consumers' views on generic medicine: a review of literature. *International Journal of Pharmacy Practice*. 2009;**17**:79–88.
- **32** Patel A, Gauld R, Norris P, Rades T. 'This body does not want free medicines': South African consumer perceptions of drug quality. *Health Policy & Planning*. 2010;**25**(1):61−9.
- **33** Håkonsen H, Toverud EL. A review of patient perspectives on generics substitution: what are the chal-

- lenges for optimal drug use. Review article. *Generics and Biosimilars Initiative Journal*. 2012;1(1):28–32.
- **34** Dowell JS, Snadden D, Dunbar JA. Rapid prescribing change, how do patients respond? *Social Science ₱ Medicine*. 1996;**43**:1543–9.
- 35 Krska J, Allison K, Delargy M, Murray L, Smith H. Implementing a statin switching programme in primary care: patients' views and experiences. *British Journal of Clincial Pharmacology*. 2012:74:147–53.
- **36** Abou-Zahr C. Non-compliance: a major problem in anaemia control. *Essential Drugs Monitor*. Available from: http://apps.who.int/medicinedocs/documents/s21229en/s21229en.pdf (last accessed 18 November 2015).
- **37** van der Geest, S, Hardon A, Whyte SR. Planning for essential drugs: are we missing the cultural dimension? *Health Policy Planning*. 1990;**2**:182–5.
- **38** Hoesli, TM, Smith KM. Effects of religious and personal beliefs on medication regimen design. *Orthopedics*. 2011;**34**(4):292–5.
- **39** Sattar SP, Ahmed MS, Madison J, Olsen DR, Bhatia SC, Ellahi S, et al. Patient and physician attitudes to using medications with religiously forbidden ingredients. *Annals of Pharmacotherapy*. 2004;**38**(11):1830–5.
- **40** Mygind A, Kristiansen M, Wittrup I, Nørgaard LS. Patient perspectives on type 2 diabetes and medicine use during Ramadan among Pakistanis. *International Journal of Clinical Pharmacy.* 2013;**35**:281–8.
- **41** Hsiao A-F, Wong MD, Goldstein MS, Yu H-J, Andersen RM, Brown ER, et al. Variation in complementary and alternative medicine (CAM) use across racial/ethnic groups and the development of ethnic-specific measures of CAM use. *Journal of Alternative & Complementary Medicine*. 2006;**12**(3):281–90.
- **42** Pound P, Britten N, Morgan M, Yardley L, Pope C, Daker-White G, Campbell R. Resisting medicines: a synthesis of qualitative studies of medicine taking. *Social Science & Medicine*. 2005;**61**(1):133−55.
- **43** Haslbeck JW, Schaeffer D. Routines in medication management: the perspective of people with chronic conditions. *Chronic Illness*, 2009;**5**:184–96.
- **44** Shoemaker SJ, de Oliveira DR. Understanding the meaning of medications for patients: the medication experience. *Pharmacy World and Science*. 2008;**30**:86–91.

- **45** Britten N. *Medicines and Society: Patients, Professionals and Dominance of Pharmaceuticals.* Basingstoke, Palgrave Macmillan, 2008.
- **46** Townsend A, Hunt K, Wyke S. Managing multiple morbidity in mid-life: a qualitative study of attitudes to drug use. *British Medical Journal*. 2003;**327**:837–42.
- **47** Krska J, Morecroft CW, Poole H, Rowe PH. The impact of using long-term medicines on quality of life: a qualitative study. *International Journal of Clinical Pharmacy.* 2013;**35**(6):1161–9.
- **48** Piette JD, Heisler M, Wagner TH. Medication characteristics beyond cost alone influence decisions to underuse pharmacotherapy in response to financial pressures. *Journal of Clinical Epidemiology*. 2006;**59**:739–46.
- **49** Stimson GV. Obeying doctor's orders: a view from the other side. *Social Science & Medicine*. 1974;**8**:97–104.
- **50** Donovan JL. Patient decision making: the missing ingredient in compliance research. *International Journal of Technology Assessment in Health Care*. 1995;**11**:443–55.
- **51** Berry DC, Michas IC, Gillie T, Forster M. What do patients want to know about their medicines and what do doctors want to tell them? A comparative study. *Psychology and Health*. 1997;**12**:467–80.
- **52** Grime J, Blenkinsopp, Raynor DFK, Pollock K, Knapp P. The role and value of written information for patients about individual medicines: a systematic review. *Health Expectations*. 2007;**10**:286–98.
- 53 Lamb GC, Green SS, Heron J. Can physicians inform patients about potential side effects without fear of causing those side effects? *Archives of Internal Medicine*. 1994;154:2753–6.
- **54** Krska J, Morecroft CW. Informing patients about medicines a hospital in-patient survey in England. *Patient Education and Counselling*, 2013;**90**:276–78.
- 55 Knapp P, Raynor DK, Woolf E, Gardner PH, Carrigan N, McMillan B. Communicating the risk of side effects to patients: an evaluation of UK regulatory recommendations. *Drug Safety*. 2009;32(10):837–49.
- 56 National Institutes of Health. Health Literacy. Available from: http://www.nih.gov/institutes-nih/nih-office-director/office-communications-public-liaison/clear-communication/health-literacy (last accessed 18 November 2015).
- **57** Bauer AM, Schillinger D, Parker MM, Katon W, Adler N, Adams AS, et al. Health literacy and antidepressant medication adherence among adults with

- diabetes: the Diabetes Study of Northern California (DISTANCE). *Journal of General Internal Medicine*. 2013;**28**(9):1181–7.
- **58** Wolf MS, Davis TC, Shrank W, Rapp DN, Bass PF, Connor UM, et al. To err is human: Patient misinterpretations of prescription drug label instructions. *Patient Education and Counselling*, 2007;**67**:293–300.
- 59 International Pharmaceutical Federation. Joint FIP/ WHO Guidelines on Good Pharmacy Practice: Standards for Quality of Pharmacy Services. Available from: https://www.fip.org/www/uploads/database_file.php?id=331&table_id= (last accessed 18 November 2015).
- **60** Britten N, Stevenson FA, Barry CA, Barber N, Bradley CP. Misunderstandings in prescribing decisions in general practice: qualitative study. *British Medical Journal*. 2000;**320**:484–8.
- **61** Roter DL, Hall JA. *Doctors Talking with Patients/Patients Talking with Doctors: Improving Communication in Medical Visits*, 2nd edn. Westport, CT, Praeger, 2006.
- **62** Vander Stichele RH, Vandeirendonck A, de Vooght G, Reynvoet B, Lammertyn J. Impact of benefit messages on patient package inserts on subjective drug perception. *Drug Information Journal*. 2002;**26**:201–8.
- **63** Raynor DK. The benefits of medicines outweigh the risks of treatment says who? *Pharmaceutical Journal*. 2013;**290**:616.
- **64** Morecroft CW, Cantrill J, Tully MP. Patients' evaluation of the appropriateness of their hypertension management a qualitative study. *Research in Social and Administrative Pharmacy*. 2006;**2**:186–211.
- **65** Barber N. What constitutes good prescribing? *British Medical Journal*. 1995;**310**:923–5.
- 66 Britten N, Campbell R, Pope C, Donovan J, Morgan M. Using meta ethnography to synthesise qualitative research: a worked example. *Journal of Health Services Research and Policy*. 2002;7:209–15.
- **67** Mintzes B, Barer ML, Kravitz RL, Kazanjian A, Bassett K, Lexchin J, et al. Influence of direct to consumer pharmaceutical advertising and patients' requests on prescribing decisions: two site cross sectional survey. *British Medical Journal*. 2002;**324**:278–9.
- **68** Horne R, Weinman J, Hankins M. The beliefs about medicines questionnaire: the development and evaluation of a new method for assessing the cognitive representation of medication. *Psychology and Health*. 1999;**14**:1–24.

- 69 Horne R, Hankins M, Jenkins R. The Satisfaction with Information about Medicines Scale (SIMS): a new measurement tool for audit and research. Quality in Health Care. 2001;10:135-40.
- 70 Atkinson MJ, Sinha A, Hass SL, Colman SS, Kumar RN, Brod M, Rowland CR. Validation of a general measure of treatment satisfaction, the Treatment Satisfaction Questionnaire for Medication (TSQM), using a national panel study of chronic disease. Health and Quality of Life Outcomes. 2004;2:12.
- 71 Farris KB, Phillips BB. Instruments assessing capacity to manage medications. Annals of Pharmacotherapy. 2008;42(7):1026-36.
- 72 Krska J, Morecroft CW, Poole H, Rowe PH. Measuring the impact of long-term medicines use from the patient perspective. International Journal of Clinical Pharmacy. 2014;36:675-8.

- 73 Avery AJ, Anderson C, Bond CM, Fortnum H, Gifford A, Hannaford PC, et al. Evaluation of patient reporting to the UK 'Yellow Card Scheme': literature review, descriptive and qualitative analyses, and questionnaire surveys. Health Technology Assessment. 2011;15(20):1234, iii-iv.
- 74 Eichler HG, Oye K, Baird LG, Abadie E, Brown J, Drum CL, Hirsch G. Adaptive licensing: taking the next step in the evolution of drug approval. Clinical Pharmacology & Therapeutics. 2010;**91**(3):426–37.
- 75 Britten N, Denford S, Stein K. Involving patients in drug licensing decisions (letter). British Medical Journal. 2013;347:f4329.
- 76 Basch E. The missing voice of patients in drugsafety reporting. New England Journal of Medicine. 2010;**362**:865-9.

- 1 Vrijens B, De Geest S, Hughes DA, Przemyslaw K, Demonceau J, Ruppar T, et al. A new taxonomy for describing and defining adherence to medications. *British Journal of Clinical Pharmacology*. 2012;**73**(5):691–705.
- **2** World Health Organization. Adherence to Long-Term Therapies: Evidence for Action. Available from: http://apps.who.int/iris/bitstream/ 10665/42682/1/9241545992.pdf (last accessed 18 November 2015).
- **3** Blaschke TF, Osterberg L, Vrijens B, Urquhart J. Adherence to medications: insights arising from studies on the unreliable link between prescribed and actual drug dosing histories. *Annual Review of Pharmacology & Toxicology*. 2012;**52**:275–301.
- **4** Vrijens B, Urquhart J, White D. Electronically monitored dosing histories can be used to develop a medication-taking habit and manage patient adherence. *Expert Reviews in Clinical Pharmacology*. 2014;**7**(5):633–44.
- **5** Pullar T, Kumar S, Tindall H, Feely M. Time to stop counting the tablets? *Clinical Pharmacology and Therapeutics*. 1989;**46**(2):163–8.
- **6** Podsadecki TJ, Vrijens BC, Tousset EP, Rode RA, Hanna GJ. 'White coat compliance' limits the reliability of therapeutic drug monitoring in HIV-1-infected patients. *HIV Clinical Trials*. 2008;**9**(4):238–46.
- **7** Patel M, Pilcher J, Travers J, Perrin K, Shaw D, Black P, et al. Use of metered-dose inhaler electronic monitoring in a real-world asthma randomized controlled trial. *Journal of Allergy and Clinical Immunology in Practice*. 2013;**1**(1):83–91.
- **8** Devonshire VA, Verdun di Cantogno E. Review of subcutaneous interferon beta-1a, delivered via the electronic self-injection device RebiSmart, for the

- treatment of multiple sclerosis. *Therapeutic Delivery*. 2011;**2**(11):1455–65.
- **9** Bruce JM, Hancock LM, Lynch SG. Objective adherence monitoring in multiple sclerosis: initial validation and association with self-report. *Multiple Sclerosis*. 2010;**16**(1):112–20.
- 10 Vrijens B, Tousset E, Rode R, Bertz R, Mayer S, Urquhart J. Successful projection of the time course of drug concentration in plasma during a 1-year period from electronically compiled dosing-time data used as input to individually parameterized pharmacokinetic models. *Journal of Clinical Pharmacology*. 2005;45(4):461–7.
- **11** Vrijens B, Urquhart J. Methods for measuring, enhancing, and accounting for medication adherence in clinical trials. *Clinical Pharmacology and Therapeutics*. 2014;**95**(6):617–26.
- 12 Demonceau J, Ruppar T, Kristanto P, Hughes DA, Fargher E, Kardas P, et al. Identification and assessment of adherence-enhancing interventions in studies assessing medication adherence through electronically compiled drug dosing histories: a systematic literature review and meta-analysis. *Drugs*. 2013;73(6):545–62.
- 13 Belknap R, Weis S, Brookens A, Au-Yeung KY, Moon G, Dicarlo L, et al. Feasibility of an ingestible sensor-based system for monitoring adherence to tuberculosis therapy. *PLoS ONE*. 2013;8(1):e53373.
- **14** Eisenberger U, Wuthrich RP, Bock A, Ambuhl P, Steiger J, Intondi A, et al. Medication adherence assessment: high accuracy of the new Ingestible Sensor System in kidney transplants. *Transplantation*. 2013;**96**(3):245–50.
- 15 US Food and Drug Administration. Guidance for Industry: Enrichment Strategies for Clinical Trials to Support Approval of Human Drugs and Biological Products. Available from: http://www.fda.gov/downloads/Drugs/ GuidanceCompliance

- RegulatoryInformation/Guidances/UCM332181. pdf (last accessed 18 November 2015).
- **16** Osterberg LG, Urquhart J, Blaschke TF. Understanding forgiveness: minding and mining the gaps between pharmacokinetics and therapeutics. *Clinical Pharmacology and Therapeutics*. 2010;**88**(4):457–9.
- 17 Horne R, Weinman J, Hankins M. The beliefs about medicines questionnaire: the development and evaluation of a new method for assessing the cognitive representation of medication. *Psychology & Health*. 1999;**14**(1):1–24.
- **18** Michie S, Richardson M, Johnston M, Abraham C, Francis J, Hardeman W, et al. The behavior change

- technique taxonomy (v1) of 93 hierarchically clustered techniques: building an international consensus for the reporting of behavior change interventions. *Annals of Behavioral Medicine*. 2013;**46**(1):81–95.
- 19 de Bruin M, Viechtbauer W, Schaalma HP, Abraham C, Hospers HJ. Standard care impact on effects of highly active antiretroviral therapy adherence interventions. *Archives of Internal Medicine*. 2010; 170(3):240–50.

- 1 King MA, Pryce RL. Evidence for compliance with long-term medication: a systematic review of randomised controlled trials. *International Journal of Clinical Pharmacy.* 2014;**36**(1):128–35.
- **2** Vrijens B, De Geest S, Hughes DA, Przemyslaw K, Demonceau J, Ruppar T, et al. A new taxonomy for describing and defining adherence to medications. *British Journal of Clinical Pharmacology*. 2012;**73**(5):691–705.
- **3** Vrijens B, Heidbuchel H. Non-vitamin K antagonist oral anticoagulants: considerations on oncevs. twice-daily regimens and their potential impact on medication adherence. *Europace*. 2015;**17**(4): 514–23.
- **4** Blaschke TF, Osterberg L, Vrijens B, Urquhart J. Adherence to medications: insights arising from studies on the unreliable link between prescribed and actual drug dosing histories. *Annual Review of Pharmacology and Toxicology*. 2012;**52**:275–.
- **5** Wroe AL. Intentional and unintentional nonadherence: a study of decision making. *Journal of Behavioral Medicine*. 2002;**25**(4):355–72.
- **6** Osterberg L, Blaschke T. Drug therapy adherence to medication. *New England Journal of Medicine*. 2005;**353**(5):487–97.
- 7 Comte L, Vrijens B, Tousset E, Gerard P, Urquhart J. Estimation of the comparative therapeutic superiority of QD and BID dosing regimens, based on integrated analysis of dosing history data and pharmacokinetics. *Journal of Pharmacokinetics and Pharmacodynamics*. 2007;34(4):549–58.
- **8** Vrijens B, Claeys MJ, Legrand V, Vandendriessche E, Van de Werf F. platelet aggregation with ticagrelor twice daily vs. clopidogrel once daily based on patient adherence data (the TWICE project). *British Journal of Clinical Pharmacology*. 2014;**77**(5):746–55.

- **9** Eichler HG, Abadie E, Breckenridge A, Flamion B, Gustafsson LL, Leufkens H, et al. Bridging the efficacy-effectiveness gap: a regulator's perspective on addressing variability of drug response. *Nature Reviews Drug Discovery*. 2011;**10**(7):495–506.
- **10** Bosman J, ter Horst PGJ, Smit JP, Dijkstra JR, Beekhuis HR, Slingersland RJ, Hospes W. Adherence of antidepressants during pregnancy: MEMS compared with three other methods. *Therapeutic Advances in Psychopharmacology*. 2014;**4**(2):61–9.
- 11 Kalichman S, Amaral C, Swetzes C, Jones M, Macy R, Kalichman M, et al. A simple single-item rating scale to measure medication adherence: further evidence for convergent validity. *Journal of the International Association of Physicians in AIDS Care*. 2009;8(6):367–674.
- 12 Vrijens B, Tousset E, Rode R, Bertz R, Mayer S, Urquhart J. Successful projection of the time course of drug concentration in plasma during a 1-year period from electronically compiled dosing-time data used as input to individually parameterized pharmacokinetic models. *Journal of Clinical Pharmacology*. 2005;45(4):461–7.
- 13 Vrijens B, Urquhart J, White D. Electronically monitored dosing histories can be used to develop a medication-taking habit and manage patient adherence. *Expert Review of Clinical Pharmacology*. 2014;7(5):633–44.
- 14 Dobbels F, Berben L, De Geest S, Drent G, Lennerling A, Whittaker C, et al. The psychometric properties and practicability of self-report instruments to identify medication nonadherence in adult transplant patients: a systematic review. *Transplantation*. 2010;90(2):205–19.
- 15 Garfield S, Clifford S, Eliasson L, Barber N, Willson A. Suitability of measures of self-reported medication adherence for routine clinical use: a sys-

- tematic review. BMC Medical Research Methodology. 2011:11:149.
- 16 AlGhurair SA, Hughes CA, Simpson SH, Guirguis LM. A systematic review of patient self-reported barriers of adherence to antihypertensive medications using the World Health Organization multidimensional adherence model. *Journal of Clinical Hypertension*. 2012;14(12):877–86.
- 17 Ramsey RR, Ryan JL, Hershey AD, Powers SW, Aylward BS, Hommel KA. Treatment adherence in patients with headache: a systematic review. *Headache*. 2014;**54**(5):795–816.
- **18** Nguyen TMU, La Caze A, Cottrell N. What are validated self-report adherence scales really measuring?: a systematic review. *British Journal of Clinical Pharmacology*. 2014;**77**(3):427–45.
- **19** Bruce JM, Hancock LM, Lynch SG. Objective adherence monitoring in multiple sclerosis: initial validation and association with self-report. *Multiple Sclerosis*. 2010;**16**(1):112–20.
- 20 Gordon SC, Yoshida EM, Lawitz EJ, Bacon BR, Sulkowski MS, Davis M, et al. Adherence to assigned dosing regimen and sustained virological response among chronic hepatitis C genotype 1 patients treated with boceprevir plus peginterferon alfa-2b/ribavirin. *Alimentary Pharmacology & Therapeutics*. 2013;38(1):16−27.
- 21 Khanam MA, Lindeboom W, Koehlmoos TLP, Alam DS, Niessen L, Milton AH. Hypertension: adherence to treatment in rural Bangladesh findings from a population-based study. *Global Health Action*. 2014;**7**:1–9.
- **22** Gelaw BK, Mohammed A, Tegegne GT, Defersha AD, Fromsa M, Tadesse E, et al. Nonadherence and contributing factors among ambulatory patients with antidiabetic medications in Adama Referral Hospital. *Journal of Diabetes Research*. 2014; article ID: 617041.
- **23** Cooper JB, Lilliston M, Brooks D, Swords B. Experience with a pharmacy technician medication history program. *American Journal of Health-System Pharmacy*. 2014;**71**(18):1567–74.
- **24** Vreeman RC, Nyandiko WM, Liu H, Tu WZ, Scanlon ML, Slaven JE, et al. Comprehensive evaluation of caregiver-reported antiretroviral therapy adherence for HIV-infected children. *Aids and Behavior*. 2015;**19**(4):626–34.
- **25** Brain C, Allerby K, Sameby B, Quinlan P, Joas E, Karilampi U, et al. Drug attitude and other predictors

- of medication adherence in schizophrenia: 12 months of electronic monitoring (MEMS (R)) in the Swedish COAST-study. *European Neuropsychopharmacology*, 2013;**23**(12):1754–62.
- 26 New York State Department of Health. Directly Observed Therapy (DOT): Information for Health Care Providers. Available from: https://www.health.ny.gov/publications/3705/ (last accessed 18 November 2015).
- **27** Strauch B, Petrak O, Zelinka T, Rosa J, Somloova Z, Indra T, et al. Precise assessment of noncompliance with the antihypertensive therapy in patients with resistant hypertension using toxicological serum analysis. *Journal of Hypertension*. 2013;**31**(12):2455–61.
- 28 Demonceau J, Ruppar T, Kristanto P, Hughes DA, Fargher E, Kardas P, et al. Identification and assessment of adherence-enhancing interventions in studies assessing medication adherence through electronically compiled drug dosing histories: a systematic literature review and meta-analysis. *Drugs*. 2013;73(6):545–62.
- **29** Vrijens B, Urquhart J. Methods for measuring, enhancing, and accounting for medication adherence in clinical trials. *Clinical Pharmacology & Therapeutics*. 2014;**95**(6):617–26.
- **30** Mkopi A, Range N, Lwilla F, Egwaga S, Schulze A, Geubbels E, et al. Validation of indirect tuberculosis treatment adherence measures in a resource-constrained setting. *International Journal of Tuberculosis and Lung Disease*. 2014;**18**(7):804–9.
- **31** Fernandez S, Chaplin W, Schoenthaler AM, Ogedegbe G. Revision and validation of the medication adherence self-efficacy scale (MASES) in hypertensive African Americans. *Journal of Behavioral Medicine*. 2008;**31**(6):453–62.
- **32** Gialamas A, Yelland LN, Ryan P, Willson K, Laurence CO, Bubner TK, et al. Does point-of-care testing lead to the same or better adherence to medication? A randomised controlled trial: the PoCT in General Practice Trial. *Medical Journal of Australia*. 2009;**191**(9):487–91.
- **33** Jonsdottir H, Opjordsmoen S, Birkenaes AB, Engh JA, Ringen PA, Vaskinn A, et al. Medication adherence in outpatients with severe mental disorders relation between self-reports and serum level. *Journal of Clinical Psychopharmacology*. 2010;**30**(2):169–75.

- **34** Tommelein E, Mehuys E, Van Tongelen I, Brusselle G, Boussery K. Accuracy of the Medication Adherence Report Scale (MARS-5) as a quantitative measure of adherence to inhalation medication in patients with COPD. *Annals of Pharmacotherapy*. 2014;**48**(5):589–95.
- **35** Almeida ED, Rodrigues LCS, Vieira JLF. Estimates of adherence to treatment of vivax malaria. *Malaria Journal*. 2014;**13**:321.
- **36** Mutschler J, von Zitzewite F, Rossler W, Grosshans M. Application of electronic diaries in patients with schizophrenia and bipolar disorders. *Psychiatria Danubina*. 2012;**24**(2):206–10.

- 1 World Health Organization. *Adherence to Long-Term Therapies: Evidence for Action*. Geneva, World Health Organization, 2003.
- **2** Wahl C, Gregoire JP, Teo K, Beaulieu M, Labelle S, Leduc B, et al. Concordance, compliance and adherence in healthcare: closing gaps and improving outcomes. *Healthcare Quality*. 2005;**8**(1):65–70.
- **3** Vrijens B, De Geest S, Hughes DA, Przemyslaw K, Demonceau J, Ruppar T, et al. A new taxonomy for describing and defining adherence to medications. *British Journal of Clinical Pharmacology*. 2012;**73**(5):691–705.
- **4** Acri T, Gross R. Studies of medication adherence. In: Strom BL, Hennessy S, eds. *Pharmacoepidemiology*. Philadelphia, PA, John Wiley & Sons, 2012: 795–809.
- **5** Ogdie A, Langan SM, Parkinson J, Dattani H, Kostev K, Gelfand JM. Medical record databases. In: Strom BL, Hennessy S, eds. *Pharmacoepidemiology*. Philadelphia, PA, John Wiley & Sons, 2012: 224–43.
- **6** Begg D. Do patients cash prescriptions? An audit in one practice. *Journal of the Royal College of General Practitioners*. 1984;**34**(262):272–4.
- **7** Beardon PH, McGilchrist MM, McKendrick AD, McDevitt DG, MacDonald TM. Primary non-compliance with prescribed medication in primary care. *British Medical Journal*. 1993;**307**(6908):846–8.
- **8** Fischer MA, Stedman MR, Lii J, Vogeli C, Shrank WH, Brookhart MA, Weissman JS. Primary medication non-adherence: analysis of 195,930 electronic prescriptions. *Journal of General Internal Medicine*. 2010;**25**(4):284–90.
- **9** Raebel MA, Ellis JL, Carroll NM, Bayliss EA, McGinnis B, Schroeder EB, et al. Characteristics of patients with primary non-adherence to

- medications for hypertension, diabetes, and lipid disorders. *Journal of General Internal Medicine*. 2012; **27**(1):57–64.
- 10 Friedman DS, Hahn SR, Gelb L, Tan J, Shah SN, Kim EE, et al. Doctor-patient communication, health-related beliefs, and adherence in glaucoma results from the Glaucoma Adherence and Persistency Study. *Ophthalmology*. 2008;115(8):1320–7, e1–3.
- 11 Jones JK, Gorkin L, Lian JF, Staffa JA, Fletcher AP. Discontinuation of and changes in treatment after start of new courses of antihypertensive drugs: a study of a United Kingdom population. *British Medical Journal*. 1995;311(7000):293–5.
- **12** Li P, McElligott S, Bergquist H, Schwartz JS, Doshi JA. Effect of the Medicare Part D coverage gap on medication use among patients with hypertension and hyperlipidemia. *Annals of Internal Medicine*. 2012;**156**(11):776–84, W-263–W-269.
- **13** Bourgault C, Senecal M, Brisson M, Marentette MA, Gregoire JP. Persistence and discontinuation patterns of antihypertensive therapy among newly treated patients: a population-based study. *Journal of Human Hypertension*. 2005;**19**(8):607–13.
- 14 Brookhart MA, Patrick AR, Schneeweiss S, Avorn J, Dormuth C, Shrank W, et al. Physician follow-up and provider continuity are associated with long-term medication adherence: a study of the dynamics of statin use. *Archives of Internal Medicine*. 2007;167(8):847–52.
- **15** Gregoire JP, Sirois C, Blanc G, Poirier P, Moisan J. Persistence patterns with oral antidiabetes drug treatment in newly treated patients a population-based study. *Value Health*. 2010;**13**(6):820–8.
- **16** Geers HC, Bouvy ML, Heerdink ER. Estimates of statin discontinuation rates are influenced by exposure and outcome definitions. *Annals of Pharmacotherapy*. 2011;**45**(5):576–81.

- 2
- **17** Bloom BS. Continuation of initial antihypertensive medication after 1 year of therapy. *Clinical Therapeutics*. 1998;**20**(4):671–81.
- **18** Lieberman JA, Stroup TS, McEvoy JP, Swartz MS, Rosenheck RA, Perkins DO, et al. Effectiveness of antipsychotic drugs in patients with chronic schizophrenia. *New England Journal of Medicine*. 2005;**353**(12):1209–23.
- **19** Qvarnstrom M, Kahan T, Kieler H, Brandt L, Hasselstrom J, Bengtsson Bostrom K, et al. Persistence to antihypertensive drug treatment in Swedish primary healthcare. *European Journal of Clinical Pharmacology.* 2013;**69**(11):1955–64.
- **20** Cooper D, Moisan J, Gregoire JP. Adherence to atypical antipsychotic treatment among newly treated patients: a population-based study in schizophrenia. *Journal of Clinical Psychiatry*. 2007;**68**(6):818–25.
- **21** Steiner JF, Prochazka AV. The assessment of refill compliance using pharmacy records: methods, val-

- idity, and applications. *Journal of Clinical Epidemiology*. 1997;**50**(1):105–16.
- **22** Steiner JF, Koepsell TD, Fihn SD, Inui TS. A general method of compliance assessment using centralized pharmacy records: description and validation. *Medical Care*. 1988;**26**(8):814–23.
- **23** Guenette L, Moisan J, Breton MC, Sirois C, Gregoire JP. Difficulty adhering to antidiabetic treatment: factors associated with persistence and compliance. *Diabetes & Metabolism.* 2013;**39**(3):250–7.
- **24** Gamble JM, McAlister FA, Johnson JA, Eurich DT. Restrictive drug coverage policies can induce substantial drug exposure misclassification in pharmacoepidemiologic studies. *Clinical Therapy*. 2012;**34**(6):1379–86, e3.
- 25 Franklin JM, Shrank WH, Pakes J, Sanfelix-Gimeno G, Matlin OS, Brennan TA, Choudhry NK. Groupbased trajectory models: a new approach to classifying and predicting long-term medication adherence. *Medical Care.* 2013;51(9):789–96.

- 1 Bosworth HB, Granger BB, Mendys P, Brindis R, Burkholder R, Czajkowski SM, et al. Medication adherence: a call for action. *American Heart Journal*. 2011;162(3):412–24.
- **2** World Health Organization. *Adherence to Long-Term Therapies: Evidence for Action*. Geneva, World Health Organization, 2003.
- **3** World Health Organization. *Introduction to Drug Utilization Research*. Geneva, World Health Organization, 2003.
- **4** Lehmann A, Aslani P, Ahmed R, Celio J, Gauchet A, Bedouch P, et al. Assessing medication adherence: options to consider. *International Journal of Clinical Pharmacy*. 2014;**36**(1):55–69.
- **5** Nieuwlaat R, Wilczynski N, Navarro T, Hobson N, Jeffery R, Keepanasseril A, et al. Interventions for enhancing medication adherence. *Cochrane Database of Systematic Reviews*. 2014;**11**:Cd000011.
- **6** Viswanathan M, Golin CE, Jones CD, Ashok M, Blalock SJ, Wines RC, et al. Interventions to improve adherence to self-administered medications for chronic diseases in the United States: a systematic review. *Annals of Internal Medicine*. 2012;**157**(11):785–95.
- **7** Zullig LL, Peterson ED, Bosworth HB. Ingredients of successful interventions to improve medication adherence. *Journal of the American Medical Association*. 2013;**310**(24):2611–12.
- 8 International Pharmaceutical Federation. Joint FIP/WHO Guidelines on GPP: Standards for Quality of Pharmacy Services. Available from: https://www.fip.org/www/uploads/database_file.php?id=331&table_id= (last accessed 18 November 2015).

- **9** Epstein RM, Street RL Jr. The values and value of patient-centered care. *Annals of Family Medicine*. 2011;**9**(2):100–3.
- **10** Kardas P, Lewek P, Matyjaszczyk M. Determinants of patient adherence: a review of systematic reviews. *Frontiers in Pharmacology*. **2013**;**4**:91.
- 11 Vrijens B, De Geest S, Hughes DA, Przemyslaw K, Demonceau J, Ruppar T, et al. A new taxonomy for describing and defining adherence to medications. *Brit-ish Journal of Clinical Pharmacology*. 2012;73(5):691–705.
- **12** Haynes RB, Ackloo E, Sahota N, McDonald HP, Yao X. Interventions for enhancing medication adherence. *Cochrane Database of Systematic Reviews*. 2008;**2**:CD000011.
- 13 Ho PM, Lambert-Kerzner A, Carey EP, Fahdi IE, Bryson CL, Melnyk SD, et al. Multifaceted intervention to improve medication adherence and secondary prevention measures after acute coronary syndrome hospital discharge: a randomized clinical trial. *Journal of the American Medical Association Internal Medicine*. 2014;174(2):186–93.
- **14** Oberje EJ, de Kinderen RJ, Evers SM, van Woerkum CM, de Bruin M. Cost effectiveness of medication adherence-enhancing interventions: a systematic review of trial-based economic evaluations. *Pharmacoeconomics*. 2013;**31**(12):1155–68.
- 15 Farooq S, Nazar Z, Irfan M, Akhter J, Gul E, Irfan U, et al. Schizophrenia medication adherence in a resource-poor setting: randomised controlled trial of supervised treatment in out-patients for schizophrenia (STOPS). *British Journal of Psychiatry*. 2011;199(6):467–72.
- **16** Gray R, Leese M, Bindman J, Becker T, Burti L, David A, et al. Adherence therapy for people with schizophrenia. European multicentre randomised

- controlled trial. *British Journal of Psychiatry*. 2006;**189**(Dec):508–14.
- 17 Lester RT, Ritvo P, Mills EJ, Kariri A, Karanja S, Chung MH, et al. Effects of a mobile phone short message service on antiretroviral treatment adherence in Kenya (WelTel Kenya1): a randomised trial. *Lancet*. 2010;376(9755):1838–45.
- **18** Morgado M, Rolo S, Castelo-Branco M. Pharmacist intervention program to enhance hypertension control: a randomised controlled trial. *International Journal of Clinical Pharmacy*. 2011;**33**(1):132–40.
- 19 Wu AW, Snyder CF, Huang IC, Skolasky R, McGruder HF, Celano SA, et al. A randomized trial of the impact of a programmable medication reminder device on quality of life in patients with AIDS. AIDS Patient Care and STDs. 2006;20(11):773–81.
- 20 Zwikker HE, van den Bemt BJ, Vriezekolk JE, van den Ende CH, van Dulmen S. Psychosocial predictors of non-adherence to chronic medication: systematic review of longitudinal studies. *Patient Preference and Adherence*. 2014;8:519–63.
- 21 Horne R, Buick D, Fisher M, Leake H, Cooper V, Weinman J. Doubts about necessity and concerns about adverse effects: identifying the types of beliefs that are associated with non-adherence to HAART. *International Journal of STDs and AIDS*. 2004;15(1):38–44.
- **22** Munro SA, Lewin SA, Swart T, Volmink J. A review of health behaviour theories: how useful are these for developing interventions to promote long-term medication adherence for TB and HIV/AIDS? *BMC Public Health*. 2007;**7**(1):104.
- 23 de Bruin M, Hospers HJ, van den Borne HW, Kok G, Prins JM. Theory- and evidence-based intervention to improve adherence to antiretroviral therapy among HIV-infected patients in the Netherlands: a pilot study. *AIDS Patient Care and STDS*. 2005;19(6):384–94.
- 24 Van Camp YP, Van Rompaey B, Elseviers MM. Nurse-led interventions to enhance adherence to chronic medication: systematic review and meta-analysis of randomised controlled trials. *European Journal of Clinical Pharmacology*. 2013;69(4):761–70.
- **25** Schneider MP, Gertsch A, Bugnon O. Cyberhealth serving to support individual intake of medication. *Swiss Medical Weekly.* 2013;**143**:w13827.

- **26** Urquhart J. The electronic medication event monitor: lessons for pharmacotherapy. *Clinical Pharmacokinetics*. 1997;**32**(5):345–56.
- 27 Vrijens B, Vincze G, Kristanto P, Urquhart J, Burnier M. Adherence to prescribed antihypertensive drug treatments: longitudinal study of electronically compiled dosing histories. *British Medical Journal*. 2008;336(7653):1114–17.
- 28 Demonceau J, Ruppar T, Kristanto P, Hughes DA, Fargher E, Kardas P, et al. Identification and assessment of adherence-enhancing interventions in studies assessing medication adherence through electronically compiled drug dosing histories: a systematic literature review and meta-analysis. *Drugs*. 2013;73(6):545–62.
- 29 Vervloet M, Linn AJ, van Weert JC, de Bakker DH, Bouvy ML, van Dijk L. The effectiveness of interventions using electronic reminders to improve adherence to chronic medication: a systematic review of the literature. *Journal of the American Medical Informatics Association*. 2012;19(5):696–704.
- **30** Linn AJ, Vervloet M, van Dijk L, Smit EG, Van Weert JC. Effects of eHealth interventions on medication adherence: a systematic review of the literature. *Journal of Medical Internet Research*. 2011;**13**(4):e103.
- **31** Hugtenburg JG, Timmers L, Elders PJ, Vervloet M, van Dijk L. Definitions, variants, and causes of nonadherence with medication: a challenge for tailored interventions. *Patient Preference and Adherence*. 2013;**7**:675–82.
- **32** Lauver DR, Ward SE, Heidrich SM, Keller ML, Bowers BJ, Brennan PF, et al. Patient-centered interventions. *Research in Nursing & Health*. 2002;**25**(4):246–55.
- 33 Blanc X, Collet T, Auer R, Fischer R, Locatelli I, Cornuz J. Do major journals in general internal medicine care about Shared Decision Making? A systematic review of 15 journals between 1996 and 2011. Available from: http://www.samw.ch/dms/de/Forschung/Bangerter/Symposium-2012/Poster/3_Blanc.pdf (last accessed 18 November 2015).
- **34** Fleury J, Cameron K. The index of readiness. In: Strickland OL, Dilorio C, eds. *Measurement of Nursing Outcomes*, 2nd edn. Berlin, Springer, 2003: 265–75.
- **35** Prochaska JO, Velicer WF. The transtheoretical model of health behavior change. *American Journal of Health Promotion*. 1997;**12**(1):38–48.

- Daeppen JB, Fortini C, Bertholet N, Bonvin R, Berney A, Michaud PA, et al. Training medical students to conduct motivational interviewing: a randomized controlled trial. *Patient Education Counsel*. 2012;**87**(3):313–18.
- Miller WR, Rollnick S. *Motivational Interviewing: Helping People Change.* New York, Guilford Press, 2012.
- 38 Shaw RJ, Kaufman MA, Bosworth HB, Weiner BJ, Zullig LL, Lee SY, et al. Organizational factors associated with readiness to implement and translate a primary care based telemedicine behavioral program to improve blood pressure control: the HTN-IMPROVE study. *Implementation Science*. 2013;8:106.
- Peters DH, Adam T, Alonge O, Agyepong IA, Tran N. Implementation research: what it is and how to do it. *British Medical Journal*. 2013;**347**:f6753.
- Mugavero MJ, Davila JA, Nevin CR, Giordano TP. From access to engagement: measuring retention in outpatient HIV clinical care. *AIDS Patient Care and STDs*. 2010;**24**(10):607–13.
- Bosworth HB. The changing face of general internal medicine and lessons learned from geriatric medicine. *Journal of General Internal Medicine*. 2014;**29**(6):824–6.
- D'Amour D, Ferrada-Videla M, San Martin Rodriguez L, Beaulieu MD. The conceptual basis for interprofessional collaboration: core concepts and theoretical frameworks. *Journal of Interprofessional Care*. 2005;**19**(Suppl. 1):116–31.
- **43** Choi BC, Pak AW. Multidisciplinarity, interdisciplinarity and transdisciplinarity in health research, services, education and policy: 1. Definitions, objectives, and evidence of effectiveness. *Clinical and Investigative Medicine*. 2006;**29**(6):351–64.
- Allen DD, Penn MA, Nora LM. Interdisciplinary healthcare education: fact or fiction? *American Journal of Pharmaceutical Education*. 2006;**70**(2):39.
- Schneider MP, Locca JF, Bugnon O, Conzelmann M. [Drug compliance in the elderly: determinants and support.] *Revue Médicale Suisse*. 2006;**2**(56):664–70.
- **46** World Medical Association. World's health professions call for new emphasis on working together. Available from: http://www.wma.net/en/40news/20archives/2013/2013_16/ (last accessed 18 November 2015).
- de la Tribonnière X. L'interdisciplinarité en éducation thérapeutique du patient: du concept à une

- proposition de critères d'évaluation. *Education Thérapeutique du Patient*. 2013;**5**(1):163–76.
- Atwal A, Caldwell K. Do multidisciplinary integrated care pathways improve interprofessional collaboration? *Scandinavian Journal of Caring Sciences*. 2002;**16**(4):360–7.
- **49** Doggrell SA. Adherence to medicines in the older-aged with chronic conditions: does intervention by an allied health professional help? *Drugs & Aging*. 2010;**27**(3):239–54.
- Harmon G, Lefante J, Krousel-Wood M. Overcoming barriers: the role of providers in improving patient adherence to antihypertensive medications. *Current Opinions in Cardiology.* 2006;**21**(4):310–15.
- 51 Shrank WH. Helping our patients to adhere to chronic medications: a new arrow for the quiver. *Journal of General Internal Medicine*. 2011;**26**(12):1394–5.
- 52 Carrion JA, Gonzalez-Colominas E, Garcia-Retortillo M, Canete N, Cirera I, Coll S, et al. A multidisciplinary support programme increases the efficiency of pegylated interferon alfa-2a and ribavirin in hepatitis C. *Journal of Hepatology*. 2013;59(5):926–33.
- Bandura A. Self-efficacy: toward a unifying theory of behavioral change. *Psychological Review*. 1977;**84**(2):191–215.
- Nachega JB, Parienti JJ, Uthman OA, Gross R, Dowdy DW, Sax PE, et al. Lower pill burden and once-daily antiretroviral treatment regimens for HIV infection: a meta-analysis of randomized controlled trials. *Clinical Infectious Diseases*. 2014;**58**(9): 1297–1307.
- Bedouch P, Roustit M, Quetant S, Chapuis C, Baudrant-Boga M, Lehmann A, et al. Development of a pharmacist collaborative care program for pulmonary arterial hypertension. *International Journal of Clinical Pharmacy*. 2011;**33**(6):898–901.
- 56 Celio J, Ninane F, Cavassini M, Bugnon O, Schneider MP. Interdisciplinary collaboration pharmacists-nurses and medication adherence programs: a review. Available from: http://www.espacomp.eu/pdf/02_Celio-1.pdf (last accessed 18 November 2015).
- Winkeljohn DL. Oral chemotherapy medications: the need for a nurse's touch. *Clinical Journal of Oncology Nursing*. 2007;**11**(6):793–6.
- Roberts AS, Benrimoj SI, Chen TF, Williams KA, Aslani P. Implementing cognitive services in community pharmacy: a review of facilitators used in

- practice change. *International Journal of Pharmacy Practice*. 2006;**14**(3):163–70.
- 59 Mansoor SM, Krass I, Aslani P. Multiprofessional interventions to improve patient adherence to cardiovascular medications. *Journal of Cardiovascular Pharmacology and Therapeutics*. 2013;18(1):19–30.
- **60** Van Camp YP, Huybrechts SA, Van Rompaey B, Elseviers MM. Nurse-led education and counselling to enhance adherence to phosphate binders. *Journal of Clinical Nursing*. 2012;**21**(9–10):1304–13.
- **61** Krummenacher I, Cavassini M, Bugnon O, Schneider MP. An interdisciplinary HIV-adherence program combining motivational interviewing and electronic antiretroviral drug monitoring. *AIDS Care*. 2011;**23**(5):550–61.
- **62** Farris KB, Cote I, Feeny D, Johnson JA, Tsuyuki RT, Brilliant S, et al. Enhancing primary care for complex patients: demonstration project using multidisciplinary teams. *Canadian Family Physician*. 2004;**50**:998–1003.
- **63** Albert NM. Improving medication adherence in chronic cardiovascular disease. *Critical Care Nurse*. 2008;**28**(5):54–64.
- **64** Stuurman-Bieze AG, Hiddink EG, van Boven JF, Vegter S. Proactive pharmaceutical care interventions improve patients' adherence to lipid-lowering medication. *Annals of Pharmacotherapy*. 2013;**47**(11):1448–56.

- 1 Sari AB, Sheldon TA, Cracknell A, Turnbull A, Dobson Y, Grant C, Gray W, Richardson A. Extent, nature and consequences of adverse events: results of a retrospective casenote review in a large NHS hospital. *Quality & Safety in Health Care*. 2007;**16**:434–9.
- **2** Vandenbroucke JP, Psaty BM. Benefits and risks of drug treatments: how to combine the best evidence on benefits with the best data about adverse effects. *Journal of the American Medical Association*. 2008;**300**(20):2417–19.
- 3 International Conference on Harmonisation of Technical Requirements for Registration of Pharmaceuticals for Human Use. ICH Harmonised Tripartite Guideline: Pharmacovigilance Planning E2E. November 2004. Available from: http://www.ich.org/fileadmin/Public_Web_Site/ICH_Products/Guidelines/Efficacy/E2E/Step4/E2E_Guideline.pdf (last accessed 18 November 2015).
- 4 European Commission. Directive 2010/84/EU of the European Parliament and of the Council of 15 December 2010 Amending, as Regards Pharmacovigilance, Directive 2001/83/EC on the Community Code Relating to Medicinal Products for Human Use. Available from: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=O-J:L:2010:348:0074:0099:EN:PDF (last accessed 18 November 2015).
- 5 European Commission. Regulation (EU) No 1235/2010 of the European Parliament and of the Council of 15 December 2010 Amending, as Regards Pharmacovigilance of Medicinal Products for Human Use, Regulation (EC) No 726/2004 Laying Down Community Procedures for the Authorisation and Supervision of Medicinal Products for Human and Veterinary Use and Establishing a European Medicines Agency, and Regulation (EC) No 1394/2007

- on Advanced Therapy Medicinal Products. Available from: http://eur-lex.europa.eu/LexUriServ/Lex-UriServ.do?uri=OJ:L:2010:348:0001:0016:EN:PDF (last accessed 18 November 2015).
- **6** European Medicines Agency. Guideline on Good Pharmacovigilance Practices (GVP): Module V Risk Management Systems (Rev. 1). June 2012. Available from: http://www.ema.europa.eu/docs/en_GB/document_library/Scientific_guideline/2012/06/WC500129134.pdf (last accessed 18 November 2015).
- **7** Raschi E, Poluzzi E, Godman B, Koci A, Moretti U, Kalaba M, et al. Torsadogenic risk of antipsychotics: combining adverse event reports with drug utilization data across Europe. *PLoS ONE*. 2013;**8**(11):e81208.
- **8** Sessler NE, Downing JM, Kale H, Chilcoat HD, Baumgartner TF, Coplan PM. Reductions in reported deaths following the introduction of extended-release oxycodone (OxyContin) with an abuse-deterrent formulation. *Pharmacoepidemiology & Drug Safety*. 2014;**23**(12):1238–46.
- **9** Layton D, Hazell L, Shakir SA. Modified prescription-event monitoring studies: a tool for pharmacovigilance and risk management. *Drug Safety*. 2011;**34**:e1–9.
- 10 European Medicines Agency. European Public Assessment Report (EPAR): Acomplia. EPAR Summary for the Public. Available from: http://www.ema.europa.eu/docs/en_GB/document_library/EPAR_-_Summary_for_the_public/human/000666/WC500021282.pdf (Accessed 2015 February 15)
- 11 Forslund T, Raaschou P, Hjemdahl P, Krakau I, Wettermark B. Usage, risk, and benefit of weightloss drugs in primary care. *Journal of Obesity*. 2011;459263.
- **12** European Commission. A Guideline on Summary of Product Characteristics. Available from: http://ec.europa.eu/health/files/eudralex/vol-2/c/smpc_

- guideline_rev2_en.pdf (last accessed 18 November 2015).
- 13 European Medicines Agency. Guideline on Good Pharmacovigilance Practices (GVP): Module XVI Risk Minimisation Measures: Tools and Effectiveness of Indicators. June 2013. Available from: http://www.ema.europa.eu/docs/en_GB/document_library/Scientific_guideline/2013/06/WC500144010.pdf (last accessed 18 November 2015).
- 14 Mol PG, Straus SM, Piening S, de Vries JT, de Graeff PA, Haaijer-Ruskamp FM. A decade of safety-related regulatory action in the Netherlands: a retrospective analysis of direct healthcare professional communications from 1999 to 2009. *Drug Safety*. 2010;33:463–74.
- 15 Panorama. The secrets of seroxat. BBC News. Available from: http://news.bbc.co.uk/2/hi/programmes/panorama/2310197.stm (last accessed 18 November 2015).
- **16** Reber KC, Piening S, Wieringa JE, Straus SM, Raine JM, de Graeff PA, et al. When direct health-care professional communications have an impact on inappropriate and unsafe use of medicines. *Clinical Pharmacology & Therapeutics*. **2013**;**93**:360–5.
- 17 Prieto L, Spooner A, Hidalgo-Simon A, Rubino A, Kurz X, Arlett P. Evaluation of the effectiveness of risk minimization measures. *Pharmacoepidemiology & Drug Safety.* 2012;**21**:896–9.
- **18** Donabedian A. The quality of care. How can it be assessed? *Journal of the American Medical Association*. 1988;**260**:1743–8.
- 19 Hoven JL, Haaijer-Ruskamp FM, Vander Stichele RH; DURQUIM Scientific Committee. Indicators of prescribing quality in drug utilisation research: report of a European meeting (DURQUIM, 13–15 May 2004). European Journal of Clinical Pharmacology. 2005;60:831–4.
- 20 Sidorenkov G, Haaijer-Ruskamp FM, de Zeeuw D, Bilo H, Denig P. Review: relation between quality-of-care indicators for diabetes and patient outcomes: a systematic literature review. *Medical Care Research and Review.* 2011;68:263–89.
- **21** Piening S, Haaijer-Ruskamp FM, de Graeff PA, Straus SM, Mol PG. Healthcare professionals'

- self-reported experiences and preferences related to direct healthcare professional communications: a survey conducted in the Netherlands. *Drug Safety*. 2012;**35**:1061–72.
- **22** Leal I, Romio SA, Schuemie M, Oteri A, Sturkenboom M, Trifirò G. Prescribing pattern of glucose lowering drugs in the United Kingdom in the last decade: a focus on the effects of safety warnings about rosiglitazone. *British Journal of Clinical Pharmacology*, 2013;**75**(3):861–8.
- 23 European Network of Centres for Pharmacoepide-miology and Pharmacovigilance. ENCePP Resource Database. Available from: http://www.encepp.eu/encepp/resourcesDatabase.jsp(last accessed 18 November 2015).
- 24 Pharmacoepidemiological Research on Outcome of Therapeutics by a European Consortium (PROTECT). Drug Consumption Databases in Europe. Available from: http://www.imi-protect.eu/drugConsumption. shtml (last accessed 18 November 2015).
- **25** Briesacher BA, Soumerai SB, Zhang F, Toh S, Andrade SE, Wagner JL, et al. A critical review of methods to evaluate the impact of FDA regulatory actions. *Pharmacoepidemiology & Drug Safety*. 2013;**22**(9):986–94.
- **26** Piening S, Haaijer-Ruskamp FM, de Vries JT, van der Elst ME, de Graeff PA, Straus SM, Mol PG. Impact of safety-related regulatory action on clinical practice: a systematic review. *Drug Safety*. 2012;**35**:373–85.
- 27 Valuck RJ, Libby AM, Orton HD, et al. Spillover effects on treatment of adult depression in primary care after FDA advisory on risk of pediatric suicidally with SSRIs. *American Journal of Psychiatry*. 2007;164:1198–205
- 28 Ramsay CR, Matowe L, Grilli R, Grimshaw JM, Thomas RE. Interrupted time series designs in health technology assessment: lessons from two systematic reviews of behavior change strategies. *International Journal of Technology Assessment in Health Care*. 2003;19:613–23.
- **29** Zuckerman IH, Lee E, Wutoh AK, Xue Z, Stuart B. Application of regression-discontinuity analysis in pharmaceutical health services research. *Health Services Research*. 2006;**41**:550–63.

- 1 De Ponti F. Global perspectives in pharmacovigilance. *Journal of Pharmacovigilance*. 2013;1:e108.
- European Parliament. Regulation (EU) 1235/2010
 2010 Pharmacovigilance Legislation. Available from: http://eur-lex.europa.eu/homepage.html (last accessed 18 November 2015).
- **3** European Council. Directive 2010/84/EU 2010 pharmacovigilance legislation. Available from: http://eur-lex.europa.eu/homepage.html?locale=it (last accessed 18 November 2015).
- **4** Bate A and Evans SJ. Quantitative signal detection using spontaneous ADR reporting, *Pharmacoepidemiology & Drug Safety*. 2009;**18**:427–36.
- 5 Harpaz R, DuMouchel W, Shah NH, Madigan D, Ryan P, Friedman C. Novel data-mining methodologies for adverse drug event discovery and analysis. *Clinical Pharmacology & Therapeutics*. 2012;**91**:1010–21.
- **6** Coloma PM, Trifiro G, Patadia V, Sturkenboom M. Postmarketing safety surveillance: where does signal detection using electronic healthcare records fit into the big picture? *Drug Safety*. 2013;**36**:183–97.
- **7** Moore N. The past, present and perhaps future of pharmacovigilance: homage to Folke Sjoqvist. *European Journal of Clinical Pharmacology.* 2013;**69**(Suppl. 1):33–41.
- **8** Hammond IW, Gibbs TG, Seifert HA, Rich DS. Database size and power to detect safety signals in pharmacovigilance. *Expert Opinions in Drug Safety.* 2007;**6**:713–21.
- 9 Poluzzi E, Raschi E, Piccinni C, De Ponti F. Data mining techniques in pharmacovigilance: analysis of the publicly accessible FDA Adverse Event Reporting System (AERS). In: Karahoca A, ed. *Data Mining Applications in Engineering and Medicine*. Croatia, InTech, 2012. Available from: http://www.intechopen.com/books/data-mining-applications-in-engineer-

- ing-and-medicine/data-mining-techniques-in-phar-macovigilance-analysis-of-the-publicly-accessible-fda-adverse-event-re (last accessed 4 January 2016)
- 10 Bergvall T, Noren GN, Lindquist M. VigiGrade: a tool to identify well-documented individual case reports and highlight systematic data quality issues. *Drug Safety*. 2014;37:65–77.
- **11** Sabate M, Pacheco JF, Ballarin E, Ferrer P, Petri H, Hasford J, et al. A compilation of research working groups on drug utilisation across Europe. *BMC Research Notes*. 2014;**7**:143.
- 12 Sabate M, Ferrer P, Ballarin E, Rottenkolber M, Amelio J, Schmiedl S, et al. Inpatient drug utilization in Europe: nationwide data sources and a review of publications on a selected group of medicines (PROTECT project). *Basic & Clinical Pharmacology & Toxicology*. 2015;116:201–11.
- **13** Lindquist M, Sanderson J, Claesson C, Imbs J, Rohan A, Edwards I. New pharmacovigilance information on an old drug, *Drug Investigation*. 1994;**8**:73–80.
- **14** Lindquist M, Pettersson M, Edwards IR, Sanderson J, Taylor N, Fletcher P, et al. Omeprazole and visual disorders: seeing alternatives. *Pharmacoepidemiology ₱ Drug Safety*. 1996;**5**:27–32.
- 15 Stahl MM, Lindquist M, Pettersson M, Edwards IR, Sanderson JH, Taylor NF, et al. Withdrawal reactions with selective serotonin re-uptake inhibitors as reported to the WHO system. *European Journal of Clinical Pharmacology*. 1997;53:163–9.
- 16 Lindquist M, Pettersson M, Edwards IR, Sanderson JH, Taylor NF, Fletcher AP, et al. How does cystitis affect a comparative risk profile of tiaprofenic acid with other non-steroidal antiinflammatory drugs? An international study based on spontaneous reports and drug usage data. ADR Signals Analysis Project (ASAP) Team. *Pharmacology & Toxicology*. 1997;80:211−17.

- 17 Lindquist M, Edwards IR. Risks of non-sedating antihistamines. *Lancet*. 1997;349:1322.
- **18** Anderson N, Borlak J. Correlation versus causation? Pharmacovigilance of the analgesic flupirtine exemplifies the need for refined spontaneous ADR reporting. *PLoS. ONE*. 2011;**6**:e25221.
- **19** Pierfitte C, Begaud B, Lagnaoui R, Moore ND. Is reporting rate a good predictor of risks associated with drugs? *British Journal of Clinical Pharmacology*. 1999;**47**:329–31.
- 20 Tavassoli N, Lapeyre-Mestre M, Sommet A, Montastruc JL. Reporting rate of adverse drug reactions to the French pharmacovigilance system with three step 2 analgesic drugs: dextropropoxyphene, tramadol and codeine (in combination with paracetamol). British Journal of Clinical Pharmacology. 2009;68:422–6.
- **21** Salvo F, Polimeni G, Moretti U, Conforti A, Leone R, Leoni O, et al. Adverse drug reactions related to amoxicillin alone and in association with clavulanic acid: data from spontaneous reporting in Italy. *Journal of Antimicrobial Chemotherapy*. 2007;**60**:121–6.

- **22** Goossens H, Ferech M, Vander SR, Elseviers M. Outpatient antibiotic use in Europe and association with resistance: a cross-national database study. *Lancet*. 2005;**365**:579–87.
- **23** Raschi E, Poluzzi E, Godman B, Koci A, Moretti U, Kalaba M, et al. Torsadogenic risk of antipsychotics: combining adverse event reports with drug utilization data across Europe. *PLoS ONE*. 2013;**8**:e81208.
- **24** Poluzzi E, Raschi E, Koci A, Moretti U, Spina E, Behr ER, et al. Antipsychotics and torsadogenic risk: signals emerging from the US FDA Adverse Event Reporting System database. *Drug Safety*. 2013;**36**:467–79.
- **25** Poluzzi E, Raschi E, Godman B, Koci A, Moretti U, Kalaba M, et al. Pro-arrhythmic potential of oral antihistamines (H1): combining adverse event reports with drug utilization data across Europe. *PLoS ONE*. **2015**;**10**:e0119551.
- **26** Salvo F, Raschi E, Moretti U, Chiarolanza A, Fourrier-Reglat A, Moore N, et al. Pharmacological prioritisation of signals of disproportionate reporting: proposal of an algorithm and pilot evaluation. *European Journal of Clinical Pharmacology*, 2014;**70**:617–25.

- 1 Arlett PR, Kurz X. New approaches to strengthen pharmacovigilance. *Drug Discovery Today: Technologies*. 2011;8:e15–19.
- 2 Bégaud B, Péré JC, Miremont G. Estimation of the denominator in spontaneous reporting. In: ARME-P Editions. *Methodological Approaches in Pharmacoepidemiology*. Amsterdam, Elsevier, 1993: 51–70.
- **3** Bégaud B. Statistical methods of evaluating pharmacovigilance data. In: Mann AE, ed. *Pharmacovigilance*. Chichester, John Wiley & Sons, 2007: 257–64.
- **4** European Commission. A Guideline on Summary of Product Characteristics. Available from: http://ec.europa.eu/health/files/eudralex/vol-2/c/smpc_guideline_rev2_en.pdf (last accessed 18 November 2015).
- 5 European Medicines Agency. Guideline on Good Pharmacovigilance Practices (GVP): Module VIII Post-Authorisation Safety Studies. Available from: http://www.ema.europa.eu/ema/index.jsp?curl=pages/regulation/docuent_listing/document_listing_000345.jsp&mid=WC0b01ac058058f32c (last accessed 18 November 2015).
- **6** Martin K, Begaud B, Latry P, Miremont-Salame G, Fourrier A, Moore N. Differences between clinical trials and postmarketing use. *British Journal of Clinical Pharmacology*. 2004;**57**:86–92.
- 7 European Medicines Agency. Guideline on Good Pharmacovigilance Practices (GVP): Module XVI Risk Minimisation Measures: Selection of Tools and Effectiveness Indicators. Available from: http://www.ema.europa.eu/ema/index.jsp?curl=pages/regulation/document_listing/document_listing_000345.jsp&mid=WC0b01ac058058f32c (last accessed 18 November 2015).
- **8** Sartor F, Walckiers D. Estimate of disease prevalence using drug consumption data. *American Journal of Epidemiology*. 1995;**141**:782–7.

- **9** Schneeweiss S, Avorn J. Postmarketing studies of drug safety. *British Medical Journal*. 2011;**342**:d342.
- 10 Leal I, Romio SA, Schuemie M, Oteri A, Sturkenboom M, Trifirò G. Prescribing pattern of glucose lowering drugs in the United Kingdom in the last decade: a focus on the effects of safety warnings about rosiglitazone. *British Journal of Clinical Pharmacology.* 2013;75(3):861–8.
- 11 Ehrenstein V, Hernandez RK, Ulrichsen SP, Rungby J, Lash TL, Riis AH, et al. Rosiglitazone use and post-discontinuation glycaemic control in two European countries, 2000–2010. *British Medical Journal Open.* 2013;3(9):e003424.
- **12** Nissen SE, Wolski K. Effect of rosiglitazone on the risk of myocardial infarction and death from cardiovascular causes. *New England Journal of Medicine*. 2007;**356**:2457–71.
- 13 Abbing-Karahagopian V, Kurz X, de Vries F, van Staa TP, Alvarez Y, Hesse U, et al. Bridging differences in outcomes of pharmacoepidemiological studies: design and first results of the PROTECT project. *Current Clinical Pharmacology*. 2014;9:130–8.
- **14** Ray WA. Evaluating medication effects outside of clinical trials: new-user designs. *American Journal of Epidemiology*. 2003;**158**:915–20.
- 15 Macias Saint-Gerons D, de la Fuente HC, Montero CD, Gil MJ, de Andres-Trelles F, Catala-Lopez F. Standard and intensive lipid-lowering therapy with statins for the primary prevention of vascular diseases: a population-based study. *European Journal of Clinical Pharmacology*. 2014;70:99–108.
- **16** Khong TP, de Vries F, Goldenberg JS, Klungel OH, Robinson NJ, Ibanez L, Petri H. Potential impact of benzodiazepine use on the rate of hip fractures in five large European countries and the United States. *Calcified Tissue International*. 2012;**91**:24–31.

- 1 Rychlik R. *Pharmacoeconomics and Outcomes Research*. Boca Raton, FL, CRC Press, 2002.
- **2** Rapier CM. *An Introduction to Outcomes Research*. London, Brookwood Medical Publications, 1996.
- **3** Porta M. *A Dictionary of Epidemiology.* New York, Oxford University Press, 2008.
- 4 Kane RL, Radosevich DM. *Conducting Health Outcomes Research*. Burlington, MA, Jones & Bartlett Learning, 2010.
- 5 Fletcher RH, Fletcher SW, Fletcher GS. *Clinical Epidemiology: The Essentials*. Philadelphia, PA, Lippincott Williams & Wilkins, 2014.
- **6** Acquadro C, Berzon R, Dubois D, Leidy NK, Marquis P, Revicki D, Rothman M. Incorporating the patient's perspective into drug development and communication: an ad hoc task force report of the Patient-Reported Outcomes (PRO) Harmonization Group meeting at the Food and Drug Administration, February 16, 2001. *Value in Health*. 2003;**6**:522–31.
- **7** Ehrenstein V, Christiansen CF, Schmidt M, Sørensen HT. Non-experimental comparative effectiveness research: how to plan and conduct a good study. *Current Epidemiological Reports*. 2014;**1**(4):206–12.
- **8** Sorensen HT, Lash TL, Rothman KJ. Beyond randomized controlled trials: a critical comparison of trials with nonrandomized studies. *Hepatology*. 2006;**44**:1075–82.
- **9** Schneeweiss S, Avorn J. A review of uses of health care utilization databases for epidemiologic research on therapeutics. *Journal of Clinical Epidemiology*. 2005;**58**:323–37.
- **10** Sox HC, Goodman SN. The methods of comparative effectiveness research. *Annual Review of Public Health*. 2012;**33**:425–45.

- **11** Tinetti ME, Studenski SA. Comparative effectiveness research and patients with multiple chronic conditions. *New England Journal of Medicine*. 2011;**364**:2478–81.
- 12 Christiansen C, Johansen M, Christensen S, O'Brien JM, Tonnesen E, Sorensen H. Preadmission metformin use and mortality among intensive care patients with diabetes: a cohort study. *Critical Care*. 2013;17:R192.
- **13** Imfeld P, Bodmer M, Jick SS, Meier CR. Metformin, other antidiabetic drugs, and risk of Alzheimer's disease: a population-based case-control study. *Journal of the American Geriatric Society*. 2012;**60**:916–21.
- **14** Thomsen RW, Riis A, Kornum JB, Christensen S, Johnsen SP, Sorensen HT. Preadmission use of statins and outcomes after hospitalization with pneumonia: population-based cohort study of 29 900 patients. *Archives of Internal Medicine*. 2008;**168**:2081–7.
- 15 Mackenzie IS, Macdonald TM, Thompson A, Morant S, Wei L. Spironolactone and risk of incident breast cancer in women older than 55 years: retrospective, matched cohort study. *British Medical Journal*. 2012;345:e4447.
- 16 Wunsch H, Christiansen CF, Johansen MB, Olsen M, Ali N, Angus DC, Sorensen HT. Psychiatric diagnoses and psychoactive medication use among nonsurgical critically ill patients receiving mechanical ventilation. *Journal of the American Medical Association*, 2014;311:1133–42.
- 17 Fuzier R, Serres I, Bourrel R, Palmaro A, Montastruc JL, Lapeyre-Mestre M. Analgesic drug consumption increases after knee arthroplasty: a pharmacoepide-miological study investigating postoperative pain. *Pain.* 2014;155:1339–45.
- **18** Ehrenstein V, Hernandez RK, Ulrichsen SP, Rungby J, Lash TL, Riis AH, et al. Rosiglitazone use and post-discontinuation glycaemic control in two

- European countries, 2000–2010. British Medical Journal Open. 2013;3:e003424.
- **19** Rothman KJ. *Epidemiology: An Introduction*. New York, Oxford University Press, 2012.
- 20 Sorensen HT, Baron JA. Medical databases. In: Olsen J, Saracci R, Trichopoulos D, eds. Teaching Epidemiology: A Guide for Teachers in Epidemiology, Public Health and Clinical Medicine. New York, Oxford University Press, 2015.
- **21** Strom BL, Carson JL. Automated data bases used for pharmacoepidemiology research. *Clinical Pharmacology and Therapeutics*. 1989;**46**:390–4.
- **22** Trifiro G, Coloma PM, Rijnbeek PR, Romio S, Mosseveld B, Weibel D, et al. Combining multiple healthcare databases for postmarketing drug and vaccine safety surveillance: why and how? *Journal of Internal Medicine*. 2014;**275**:551–61.
- **23** Avillach P, Coloma PM, Gini R, Schuemie M, Mougin F, Dufour JC, et al. Harmonization process for the identification of medical events in eight European healthcare databases: the experience from the EU-ADR project. *Journal of the American Medical Information Association*. 2013;**20**:184–92.
- **24** Gagne JJ, Fireman B, Ryan PB, Maclure M, Gerhard T, Toh S, et al. Design considerations in an active medical product safety monitoring system. *Pharmacoepidemiology & Drug Safety*. 2012;**21**(Suppl. 1):32–40.
- **25** Sterrantino G, Trifiro G, Lapi F, Pasqua A, Mazzaglia G, Piccinni C, et al. Burden of community-acquired pneumonia in Italian general practice. *European Respiratory Journal*. 2013;**42**:1739–42.
- **26** Ferrajolo C, Verhamme KM, Trifiro G, 't Jong GW, Giaquinto C, Picelli G, et al. Idiopathic acute liver injury in paediatric outpatients: incidence and signal detection in two European countries. *Drug Safety*. 2013;**36**:1007–16.
- 27 Schneeweiss S, Rassen JA, Glynn RJ, Myers J, Daniel GW, Singer J, et al. Supplementing claims data with outpatient laboratory test results to improve confounding adjustment in effectiveness studies of lipid-lowering treatments. *BMC Medical Research Methodology.* 2012;12:180.
- 28 Valkhoff VE, Coloma PM, Masclee GM, Gini R, Innocenti F, Lapi F, et al. Validation study in four health-care databases: upper gastrointestinal bleeding misclassification affects precision but not magnitude of drug-related upper gastrointestinal bleeding risk. *Journal of Clinical Epidemiology*. 2014;67:921–31.

- 29 Cavagna L, Caporali R, Trifiro G, Arcoraci V, Rossi S, Montecucco C. Overuse of prescription and OTC non-steroidal anti-inflammatory drugs in patients with rheumatoid arthritis and osteoarthritis. *International Journal of Immunopathology & Pharmacology*. 2013;26:279−81.
- **30** Lawrenson R, Williams T, Farmer R. Clinical information for research; the use of general practice databases. *Journal of Public Health Medicine*. 1999;**21**:299–304.
- 31 Fischer MA, Stedman MR, Lii J, Vogeli C, Shrank WH, Brookhart MA, Weissman JS. Primary medication non-adherence: analysis of 195 930 electronic prescriptions. *Journal of General Internal Medicine*. 2010;25:284–90.
- 32 Coloma PM, Schuemie MJ, Trifiro G, Gini R, Herings R, Hippisley-Cox J, et al. Combining electronic healthcare databases in Europe to allow for large-scale drug safety monitoring: the EU-ADR Project. *Pharmacoepidemiology & Drug Safety.* 2011;20:1–11.
- **33** Wettermark B, Zoega H, Furu K, Korhonen M, Hallas J, Norgaard M, et al. The Nordic prescription databases as a resource for pharmacoepidemiological research a literature review. *Pharmacoepidemiology & Drug Safety*. 2013;**22**:691–9.
- **34** Wu AW, Snyder C, Clancy CM, Steinwachs DM. Adding the patient perspective to comparative effectiveness research. *Health Affairs*. 2010;**29**:1863–71.
- 35 European Network for Health Technology Assessment. Endpoints Used for Relative Effectiveness Assessment of Pharmaceuticals: Health-Related Quality of Life and Utility Measures. Available from: https://5026.fedimbo.belgium.be/sites/5026.fedimbo.belgium.be/files/Health-related%20quality%20of%20life.pdf (last accessed 18 November 2015).
- **36** Chang JT, Hays RD, Shekelle PG, MacLean CH, Solomon DH, Reuben DB, et al. Patients' global ratings of their health care are not associated with the technical quality of their care. *Annals of Internal Medicine*. 2006;**144**:665–72.
- **37** Rao M, Clarke A, Sanderson C, Hammersley R. Patients' own assessments of quality of primary care compared with objective records based measures of technical quality of care: cross sectional study. *British Medical Journal*. 2006;**333**:19.
- **38** Schneider EC, Zaslavsky AM, Landon BE, Lied TR, Sheingold S, Cleary PD. National quality monitoring of Medicare health plans: the relationship between

- enrollees' reports and the quality of clinical care. *Medical Care*. 2001;**39**:1313–25.
- **39** Sequist TD, Schneider EC, Anastario M, Odigie EG, Marshall R, Rogers WH, Safran DG. Quality monitoring of physicians: linking patients' experiences of care to clinical quality and outcomes. *Journal of General Internal Medicine*. 2008;**23**:1784–90.
- **40** Isaac T, Zaslavsky AM, Cleary PD, Landon BE. The relationship between patients' perception of care and measures of hospital quality and safety. *Health Services Research.* 2010;**45**:1024–40.
- **41** Lehrman WG, Elliott MN, Goldstein E, Beckett MK, Klein DJ, Giordano LA. Characteristics of hospitals demonstrating superior perfor-

- mance in patient experience and clinical process measures of care. *Medical Care Research and Review*. 2010;**67**(1):38–55.
- **42** Black N, Varaganum M, Hutchings A. Relationship between patient reported experience (PREMs) and patient reported outcomes (PROMs) in elective surgery. *British Medical Journal Quality & Safety*. 2014;**23**:534–42.
- **43** Llanwarne NR, Abel GA, Elliott MN, Paddison CA, Lyratzopoulos G, Campbell JL, Roland M. Relationship between clinical quality and patient experience: analysis of data from the English quality and outcomes framework and the National GP Patient Survey. *Annals of Family Medicine*. 2013;**11**:467–72.

- 1 Institute for Healthcare Informatics. The Global Use of Medicines: Outlook Through 2017. Available from: http://www.imshealth.com/en/thoughtleadership/ims-institute/reports/global-use-of-medicines-outlook-through-2017 (last accessed 18 November 2015).
- **2** Drummond MF. *Methods for the Economic Evaluation of Health Care Programmes*. Oxford, Oxford University Press, 2005.
- **3** Byford S, Raftery J. Perspectives in economic evaluation. *British Medical Journal*. 1998;**316**:1529–30.
- **4** Hill SR, Mitchell AS, Henry DA. Problems with the interpretation of pharmacoeconomic analyses: a review of submissions to the Australian Pharmaceutical Benefits Scheme. *Journal of the American Medical Association*. 2000;**283**:2116–21.
- 5 Anis AH, Rahman T, Schechter MT. Using pharmacoeconomic analysis to make drug insurance coverage decisions. *Pharmacoeconomics*. 1998;13:119–26.
- **6** Commonwealth Department of Health and Ageing. Guidelines for the Pharmaceutical Industry on Preparation of Submissions to the Pharmaceutical Benefits Advisory Committee. Canberra, Commonwealth of Australia, 1992.
- **7** Ontario Ministry of Health and Long-Term Care. Ontario Guidelines for Economic Analysis of Pharmaceutical Products. Available from: http://www.health.gov.on.ca/en/pro/programs/drugs/economic/economic_mn.aspx (last accessed 18 November 2015).
- **8** Langley PC. Formulary submission guidelines for Blue Cross and Blue Shield of Colorado and Nevada. Structure, application and manufacturer responsibilities. *Pharmacoeconomics*. 1999;**16**:211–24.
- **9** Husereau D, Drummond M, Petrou S, Carswell C, Moher D, Greenberg D, et al. Consolidated

- Health Economic Evaluation Reporting Standards (CHEERS) statement. *Value in Health*. 2013;**16**:e1–5.
- **10** Sculpher MJ, Claxton K, Drummond M, McCabe C. Whither trial-based economic evaluation for health care decision making? *Health Economics*. 2006;**15**:677–87.
- **11** Hughes DA. Modelling in health economics. In: Walley T, Haycox A, Boland A, eds. *Pharmacoeconomics*. Edinburgh, Churchill Livingstone, 2004.
- **12** Weinstein MC. Recent developments in decisionanalytic modelling for economic evaluation. *Pharmacoeconomics*, 2006;**24**:1043–53.
- **13** Brennan A, Chick SE, Davies R. A taxonomy of model structures for economic evaluation of health technologies. *Health Economics*. 2006;**15**:1295–310.
- 14 Rochau U, Jahn B, Qerimi V, Burger EA, Kurzthaler C, Kluibenschaedl M, et al. Decision-analytic modeling studies: an overview for clinicians using multiple myeloma as an example. *Critical Reviews in Oncology & Hematology*. 2015;94(2):164–78.
- **15** Petrou S, Gray A. Economic evaluation using decision analytical modelling: design, conduct, analysis, and reporting. *British Medical Journal*. 2011;**342**: d1766.
- 16 Steele MJ. Dimensions of credibility in models and simulations. Proceedings of the 2008 Summer Computer Simulation Conference. Article No. 57. Available from: http://dl.acm.org/citation. cfm?id=2367713 (last accessed 18 November 2015).
- 17 Lorscheid I, Heine BO, Meyer M. Opening the 'back box' of simulations: increased transparency of simulation models and effective results reports through the systematic design of experiments. *Computational and Mathematical Organization Theory*. 2012;18(1):22–62.
- **18** Kijowski DJ. Responsible conduct of research with computational models. MS Thesis, 2010.

- 19 Caro JJ, Briggs AH, Siebert U, Kuntz KM. Modeling good research practices overview: a report of the ISPOR-SMDM Modeling Good Research Practices Task Force-1. *Medical Decision Making*. 2012;32(5):667–77.
- **20** Von Korff M, Wagner EH, Saunders K. A chronic disease score from automated pharmacy data. *Journal of Clinical Epidemiology*. 1992;**45**:197–203.
- **21** Fishman PA, Goodman MJ, Hornbrook MC, Meenan RT, Bachman DJ, O'Keeffe Rosetti MC. Risk adjustment using automated ambulatory pharmacy data: the RxRisk model. *Medical Care*. 2003;**41**:84–99.
- **22** Andre T, Sargent D, Tabernero J, O'Connell M, Buyse M, Sobrero A, et al. Current issues in adjuvant treatment of stage II colon cancer. *Annals of Surgical Oncology*. 2006;**13**:887–98.
- **23** Jansman FG, Postma MJ, Brouwers JR. Cost considerations in the treatment of colorectal cancer. *Pharmacoeconomics*. 2007;**25**:537–62.
- **24** Rajpal S, Venook AP. Targeted therapy in colorectal cancer. *Clinical Advances in Hematology & Oncology*. 2006:**4**:124–32.
- **25** Tilson L, Sharp L, Usher C, Walsh C, O'Ceilleachair A, Stuart C, et al. Cost of care for colorectal cancer in Ireland: a health care payer perspective. *European Journal of Health Economics*. 2012;**13**:511–24.
- 26 Concato J, Shah N, Horwitz RI. Randomized, controlled trials, observational studies, and the hierarchy of research designs. New England Journal of Medicine. 2000:342:1887–92.
- **27** Concato J. Observational versus experimental studies: what's the evidence for a hierarchy? *NeuroRx*. 2004;**1**:341–7.
- **28** Avorn J. In defense of pharmacoepidemiology embracing the yin and yang of drug research. *New England Journal of Medicine*. 2007;**357**:2219–21.
- **29** Schneeweiss S, Avorn J. Postmarketing studies of drug safety. *British Medical Journal*. 2011;**342**:d342.
- 30 Berger ML, Mamdani M, Atkins D, Johnson ML. Good research practices for comparative effectiveness research: defining, reporting and interpreting nonrandomized studies of treatment effects using secondary data sources: the ISPOR Good Research Practices for Retrospective Database Analysis Task Force Report – Part I. Value in Health. 2009;12:1044–52.
- **31** Vrijens B, De Geest S, Hughes DA, Przemyslaw K, Demonceau J, Ruppar T, et al. A new taxonomy

- for describing and defining adherence to medications. *British Journal of Clinical Pharmacology*. 2012;**73**:691–705.
- **32** DiMatteo MR, Giordani PJ, Lepper HS, Croghan TW. Patient adherence and medical treatment outcomes: a meta-analysis. *Medical Care*. 2002;**40**:794–811.
- **33** Hughes D, Cowell W, Koncz T, Cramer J. Methods for integrating medication compliance and persistence in pharmacoeconomic evaluations. *Value in Health*. 2007;**10**:498–509.
- **34** Hughes DA, Tilson L, Drummond M. Estimating drug costs in economic evaluations in Ireland and the UK: an analysis of practice and research recommendations. *Pharmacoeconomics*. 2009;**27**:635–43.
- **35** Hay JW, Smeeding J, Carroll NV, Drummond M, Garrison LP, Mansley EC, et al. Good research practices for measuring drug costs in cost effectiveness analyses: issues and recommendations: the ISPOR Drug Cost Task Force report Part I. *Value in Health*. 2010;**13**:3–7.
- 36 Health and Social Care Information Centre 2014. Use of NICE Appraised Medicines in the NHS in England – 2012, Experimental Statistics. Table 1. Available from: http://www.hscic.gov.uk/catalogue/ PUB13413/use-nice-app-med-nhs-exp-stat-eng-12-rep.pdf (last accessed 18 November 2015).
- **37** Carlson JJ, Sullivan SD, Garrison LP, Neumann PJ, Veenstra DL. Linking payment to health outcomes: a taxonomy and examination of performance-based reimbursement schemes between healthcare payers and manufacturers. *Health Policy*. 2010;**96**:179–90.
- **38** Walker S, Sculpher M, Claxton K, Palmer S. Coverage with evidence development, only in research, risk sharing, or patient access scheme? A framework for coverage decisions. *Value in Health*. 2012;**15**:570–9.
- **39** Holloway K, Green T. *Drug and Therapeutics Committees: A Practical Guide*. Geneva, World Health Organization, 2003.
- **40** Mamdani M, McNeely D, Evans G, Hux J, Oh P, Forde N, Conly J. Impact of a fluoroquinolone restriction policy in an elderly population. American Journal of Medicine. 2007;**120**:893–900.
- **41** Usher C, Tilson L, Bennett K, Barry M. Cost containment interventions introduced on the community drugs schemes in Ireland-evaluation of expenditure trends using a national prescription claims database. *Clinical Therapy.* 2012;**34**:632–9.

- 1 Campbell SM, Braspenning J, Hutchinson A, Marshall A. Research methods used in developing and applying quality indicators in primary care. Quality and Safety in Health Care. 2002;11:358–64.
- 2 Hoven JL, Haaijer-Ruskamp FM, Vander Stichele RH; DURQUIM Scientific Committee. Indicators of prescribing quality in drug utilisation research: report of a European meeting (DURQUIM, 13–15 May 2004). European Journal of Clinical Pharmacology. 2005;60:831–4.
- 3 Institute of Medicine. Institute of Medicine Committee on the Quality of Health Care in America. Crossing the Quality Chasm: A New Health System for the 21st Century. Washington, DC, National Academy Press, 2001.
- 4 de Vries TPGM, Henning RH, Hogerzeil HV, Fresle DA. WHO Guide to Good Prescribing A Practical Manual. Available from: http://apps.who.int/medicinedocs/pdf/whozip23e/whozip23e.pdf (last accessed 18 November 2015).
- **5** Agency for Healthcare Research and Quality. National Quality Measure Clearinghouse. Available from: http://www.qualitymeasures.ahrq.gov/ (last accessed 18 November 2015).
- **6** Budnitz DS, Lovegrove MC, Shehab N, Richards CL. Emergency hospitalizations for adverse drug events in older Americans. New England Journal of Medicine. 2011;**365**:2002–12.
- 7 Martirosyan L, Voorham J, Haaijer-Ruskamp FM, Braspenning J, Wolffenbuttel BH, Denig P. A systematic literature review: prescribing indicators related to type 2 diabetes mellitus and cardiovascular risk management. Pharmacoepidemiology & Drug Safety. 2010;19:319–34.
- **8** HRSA Health Disparities Collaboratives: Diabetes Collaborative. Available from: http://www.qualitymeasures.ahrq.gov/browse/by-organization-

- indiv.aspx?orgid=1798 (last accessed 18 November 2015).
- **9** Australian Institute of Health and Welfare. Towards National Indicators of Safety and Quality in Health Care. Available from: http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=6442457172 (last accessed 18 November 2015).
- 10 British Medical Association. England QOF Guidance 7th Revision 2014–2015. Available from: http://downloadmp3.site/download/bma-qof-guidance-latest-revision-british-medical- (last accessed 18 November 2015).
- 11 National Quality Forum. National Voluntary Consensus Standards for Ambulatory Care Using Clinically Enriched Administrative Data. —Available from: http://www.qualityforum.org/projects/ambulatory_clinically_enriched_data.aspx (last accessed 18 November 2015).
- 12 Voorham J, Haaijer-Ruskamp FM, van der Meer K, de Zeeuw D, Wolffenbuttel BH, Hoogenberg K, Denig P; GIANTT-Group. Identifying targets to improve treatment in type 2 diabetes; the Groningen Initiative to ANalyse Type 2 diabetes Treatment (GIANTT) observational study. Pharmacoepidemiology & Drug Safety. 2010;19:1078–86.
- 13 Groningen Initiative to ANalyse Type 2 diabetes Treatment. Spiegelinformatie voorbeeld test praktijk [Sample General Practitioner Feedback Information]. Available from: http://giantt.nl/bm_311.pdf (last accessed 18 November 2015).
- **14** O'Connor PJ, Bodkin NL, Fradkin J, Glasgow RE, Greenfield S, Gregg E, et al. Diabetes performance measures: current status and future directions. Diabetes Care. 2011;34:1651–9. Erratum in: Diabetes Care. 2011;34:2631.
- **15** Guthrie B, Inkster M, Fahey T. Tackling therapeutic inertia: role of treatment data in quality indicators. British Medical Journal. 2007;335(7619):542–4.

- 16 Drozda J, Messer JV, Spertus J. ACCF/AHA/AMA-PCPI 2011 performance measures for adults with coronary artery disease and hypertension: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Performance Measures and the American Medical Association-Physician Consortium for Performance Improvement. Journal of the American College of Cardiology. 2011;58:316–36.
- 17 Luehr D, Woolley T, Burke R, Dohmen F, Hayes R, Johnson M, et al.; Institute for Clinical Systems Improvement. Hypertension Diagnosis and Treatment. Available from: https://www.icsi.org/_asset/wjqy4g/HTN.pdf (last accessed 18 November 2015).
- **18** de Vries ST, Voorham J, Haaijer-Ruskamp FM, Denig P. Potential overtreatment and undertreatment of diabetes in different patient age groups in primary care after the introduction of performance measures. *Diabetes Care*. **2014;37**:1312–20.
- **19** Sidorenkov G, Haaijer-Ruskamp FM, de Zeeuw D, Denig P. A longitudinal study examining adherence to guidelines in diabetes care according to different definitions of adequacy and timeliness. *PLoS ONE*. 2011;6:e24278.
- **20** Voorham J, Denig P, Wolffenbuttel BH, Haaijer-Ruskamp FM. Cross-sectional versus sequential quality indicators of risk factor management in patients with type 2 diabetes. *Medical Care*. 2008;**46**:133–41.
- **21** Sidorenkov G, Voorham J, Haaijer-Ruskamp FM, de Zeeuw D, Denig P. Association between performance measures and glycemic control among patients with diabetes in a community-wide primary care cohort. Medical Care. 2013;**51**:172–9.
- **22** Sidorenkov G, Voorham J, de Zeeuw D, Haaijer-Ruskamp FM, Denig P. Treatment quality indicators predict short term outcomes in diabetes patients: a prospective cohort study using the GIANTT database. British Medical Journal Quality & Safety. 2013;22:339–47.
- 23 Kerr EA, Lucatorto MA, Holleman R, Hogan MM, Klamerus ML, Hofer TP, et al. Monitoring performance for blood pressure management among patients with diabetes mellitus: too much of a good thing? Archives of Internal Medicine. 2012;172:938–45.
- **24** Choe HM, Bernstein SJ, Standiford CJ, Hayward RA. New diabetes HEDIS blood pressure quality

- measure: potential for overtreatment. American Journal of Managed Care. 2010;**16**:19–24.
- **25** Pogach L, Aron D. The other side of quality improvement in diabetes for seniors: a proposal for an overtreatment glycemic measure. *Archives of Internal Medicine*. 2012;**172**:1510–12.
- **26** Handberg E. How do guidelines impact measures of performance? Can they keep up? *Archives of Internal Medicine*. 2012;172:945–6.
- 27 Sidorenkov G, Haaijer-Ruskamp FM, de Zeeuw D, Bilo HJG, Denig P. Review: relation between quality-of-care indicators for diabetes and patient outcomes: a systematic literature review. *Medical Care Research and Review*. 2011;68:263–89.
- **28** Ashworth M, Golding S, Majeed A. Prescribing indicators and their use by primary care groups to influence prescribing. *Journal of Clinical Pharmacology & Therapeutics*. 2002;27:197–04.
- **29** Norman C, Zarrinkoub R, Hasselström J, Godman B, Granath F, Wettermark B. Potential savings without compromising the quality of care. *International Journal of Clinical Practice.*. 2009;**63**:1320–6.
- **30** Muijrers PE, Janknegt R, Sijbrandij J, Grol RP, Knottnerus JA. Prescribing indicators. Development and validation of guideline-based prescribing indicators as an instrument to measure the variation in the prescribing behaviour of general practitioners. *European Journal of Clinical Pharmacology*. 2004;**60**:739–46.
- **31** MacKinnon NJ, Hartnell NR, Black EK, Dunbar P, Johnson J, Halliday-Mahar S, et al. Development of clinical indicators for type 2 diabetes. *Canadian Pharmacists Journal*. 2009;**141**:120–8.
- **32** Dreischulte T, Grant AM, McCowan C, McAnaw JJ, Guthrie B. Quality and safety of medication use in primary care: consensus validation of a new set of explicit medication assessment criteria and prioritization of topics for improvement. BMC *Clinical Pharmacology*. 2012;**12**:5.
- 33 Bally K, Buechel RR, Buser P, Tschudia P, Martinaa B, Zeller A. Discontinuation of secondary prevention medication after myocardial infarction the role of general practitioners and patients. *Swiss Medical Weekly.* 2013;**143**:w13896.
- **34** American Geriatrics Society 2012 Beers Criteria Update Expert Panel. American Geriatrics Society updated Beers Criteria for potentially inappropriate

- medication use in older adults. *Journal of the American Geriatric Society.*, 2012;**60**:616–31.
- **35** Jano E, Aparasu RR. Healthcare outcomes associated with Beers' criteria: a systematic review. *Annals of Pharmacotherapy*. 2007;**41**:438–47.
- **36** Albert SM, Colombi A, Hanlon J. Potentially inappropriate medications and risk of hospitalization in retirees: analysis of a US retiree health claims database. *Drugs & Aging*. 2010;**27**:407−15.
- 37 National Committee for Quality Assurance. HEDIS 2013: Healthcare Effectiveness Data and Information Set. Vol. 1, Narrative. Available from: http://www.ncqa.org/HEDISQualityMeasurement/HEDISMeasures/HEDIS2013.aspx (last accessed 18 November 2015).
- **38** Spinewine A, Schmader KE, Barber N, Hughes C, Lapane KL, Swine C, Hanlon JT. Appropriate prescribing in elderly people: how well can it be measured and optimized? *Lancet*. 2007;**370**(9582):173–84.
- **39** Levy HB, Marcus EL, Christen C. Beyond the Beers criteria: a comparative overview of explicit criteria. *Annals of Pharmacotherapy*. 2010;**44**:1968–75.
- **40** Holt S, Schmiedl S, Thürmann PA. Potentially inappropriate medications in the elderly: the PRISCUS list. *Deutsches Ärzteblatt International*. 2010;**107**(31–2):543–51.
- 41 Gallagher P, Ryan C, Byrne S, Kennedy J, O'Mahony D. STOPP (Screening Tool of Older Person's Prescriptions) and START (Screening Tool to Alert doctors to Right Treatment). Consensus validation. *International Journal of Clinical Pharmacology & Therapeutics*. 2008;46:72–83.
- **42** Hill-Taylor B, Sketris I, Hayden J, Byrne S, O'Sullivan D, Christie R. Application of the STOPP/START criteria: a systematic review of the prevalence of potentially inappropriate prescribing in older adults, and evidence of clinical, humanistic and economic impact. *Journal of Clinical Pharmacology & Therapeutics*. 2013;**38**:360−72.
- **43** Hamilton H, Gallagher P, Ryan C, Byrne S, O'Mahony D. Potentially inappropriate medications defined by STOPP criteria and the risk of adverse drug events in older hospitalized patients. *Archives of Internal Medicine*. 2011;**171**:1013–19.
- **44** O'Mahony D, O'Sullivan D, Byrne S, O'Connor MN, Ryan C, Gallagher P. STOPP/START criteria for potentially inappropriate prescribing in older people: version 2. *Age & Ageing*. 2015;**44**(2):213−18.

- **45** Ryan C, O'Mahony D, O'Donovan DO, O'Grady E, Weedle P, Kennedy J, Byrne S. A comparison of the application of STOPP/START to patients' drug lists with and without clinical information. *International Journal of Clinical Pharmacy*. 2013;**35**:230–5.
- **46** Shrank WH, Polinski JM, Avorn J. Quality indicators for medication use in vulnerable elders. *Journal of the American Geriatric Society*. 2007;**55**(Suppl. 2):S373–82.
- **47** Rand Health. Quality Indicators ACOVE 3. Available from: http://www.rand.org/health/projects/acove/acove3.html (last accessed 18 November 2015).
- **48** Avery AJ, Dex GM, Mulvaney C, Serumaga B, Spencer R, Lester HE, Campbell SM. Development of prescribing-safety indicators for GPs using the RAND appropriateness method. *British Journal of General Practice*. 2011;**61**:e526–36.
- **49** Hilmer SN, Mager DE, Simonsick EM, Cao Y, Ling SM, Windham BG, et al. A drug burden index to define the functional burden of medications in older people. *Archives of Internal Medicine*. 2007;**167**(8):781–7.
- **50** Hilmer SN, Gnjidic D. The effects of polypharmacy in older adults. *Clinical Pharmacology & Therapeutics*. 2009;**85**:86−8.
- **51** Viktil KK, Blix HS, Moger TA, Reikvam A. Polypharmacy as commonly defined is an indicator of limited value in the assessment of drug-related problems. *British Journal of Clinical Pharmacology*. 2007;**63**:187–95.
- **52** Ivers N, Jamtvedt G, Flottorp S, Young JM, Odgaard-Jensen J, French SD, et al. Audit and feedback: effects on professional practice and healthcare outcomes. *Cochrane Database of Systematic Reviews*. 2012;**6**:CD000259.
- **53** Health & Social Care Information Centre. Prescribing. Available from: http://www.hscic.gov.uk/Article/1689 (last accessed 18 November 2015).
- **54** Dutch Institute for Rational Use of Medicine website: http://www.medicijngebruik.nl/ondersteuning-fto/ verbeteren-voorschrijfgedrag.
- 55 van den Berg MJ, Kringos DS, Marks LK, Klazinga NS. The Dutch health care performance report: seven years of health care performance assessment in the Netherlands. *Health Research Policy and Systems*. 2014;12:1.
- 56 World Health Organization. How to Investigate Drug Use in Health Facilities: Selected Drug Use Indicators – EDM Research Series No. 007. Available from:

- http://apps.who.int/medicinedocs/en/d/Js2289e/ (last accessed 18 November 2015).
- **57** Goossens H, Ferech M, Vander Stichele R, Elseviers M; ESAC Project Group. Outpatient antibiotic use in Europe and association with resistance: a cross-national database study. *Lancet*. 2005;**365**:579–87.
- 58 Adriaenssens N, Coenen S, Tonkin-Crine S, Verheij TJ, Little P, Goossens H; on behalf of the ESAC Project Group. European Surveillance of Antimicrobial Consumption (ESAC): disease-specific quality indicators for outpatient antibiotic prescribing. *British Medical Journal Quality & Safety*. 2011;20:764–72.
- **59** Campbell SM, Reeves D, Kontopantelis E, Sibbald B, Roland M. Effects of pay-for-performance on the quality of primary care in England. *New England Journal of Medicine*. 2009;**361**(4):368–78.
- **60** Integrated Healthcare Association. Measurement Year 2014. Available from: http://www.iha.org/manuals_operations_2014.html (last accessed 18 November 2015).
- **61** Shekelle PG. Quality indicators and performance measures: methods for development need more standardization. *Journal of Clinical Epidemiology*. 2013;**66**:1338–9.

- 1 World Health Organization. Joint FIP/WHO Guidelines on Good Pharmacy Practice: Standards for Quality of Pharmacy Services. Available from: http://apps.who.int/medicinedocs/documents/s18676en/s18676en.pdf (last accessed 18 November 2015).
- 2 International Pharmaceutical Federation. Good Pharmacy Practice in Developing Countries (GPP): Recommendations for Stepwise Implementation. Available from: http://www.fip.org/files/fip/Statements/latest/Dossier%20003%20total.PDF (last accessed 18 November 2015).
- 3 The Pharmacy Guild of Australia. Dispensing Your Prescription Medicine: More than Sticking a Label on a Bottle. Available from: http://www.guild.org.au/docs/default-source/public-documents/issues-and-resources/Fact-Sheets/the-dispensing-process.pdf?sfvrsn=0 (last accessed 18 November 2015).
- **4** Royal Pharmaceutical Society of Great Britain. Practice Guidance. Good Dispensing Guidelines England. Available from: http://www.rpharms.com/practice-science-and-research-pdfs/good-dispensing-guidelines.pdf (last accessed 18 November 2015).
- **5** Smith F. The quality of private pharmacy services in low and middle-income countries: a systematic review. *Pharmacy World & Science*. 2009;**31**:351–61.
- **6** James KL, Barlow D, McArtney R, Hiom S, Roberts D, Whittlesea C. Incidence, type and causes of dispensing errors: a review of the literature. *International Journal of Pharmacy Practice*. 2009;**17**:9–30.
- **7** Beso A, Franklin BD, Barber N. The frequency and potential causes of dispensing errors in a hospital pharmacy. *Pharmacy World & Science*. 2005;**27**:182–90.

- **8** Knudsen P, Herborg H, Mortensen AR, Knudsen M, Hellebek A. Preventing medication errors in community pharmacy: frequency and seriousness of medication errors. *Quality & Safety in Health Care*. 2007;**16**:291−6.
- 9 Knudsen P, Herborg H, Mortensen AR, Knudsen M, Hellebek A. Preventing medication errors in community pharmacy: root-cause analysis of transcription errors. *Quality & Safety in Health Care*. 2007;16:285–90.
- **10** Rupp MT. Value of community pharmacists' interventions to correct prescribing errors. *Annals of Pharmacotherapy*. 1992;**26**:1580–4.
- **11** Buurma H, De Smet PA, Leufkens HG, et al. Evaluation of the clinical value of pharmacists' modifications of prescription errors. *British Journal of Clinical Pharmacology*. 2004;**58**:503–11.
- 12 Braund R, Furlan HM, George K, Havell M, Murphy JL, West MK. Interventions performed by New Zealand community pharmacists while dispensing prescription medications. *Pharmacy World & Science*. 2010;32:22−5.
- **13** Pottegård A, Hallas J, Søndergaard J. Pharmaceutical interventions on prescription problems in a Danish pharmacy setting. *International Journal of Clinical Pharmacy*. 2011;**33**:1019–27.
- **14** Warholak TL, Rupp MT. Analysis of community chain pharmacists' interventions on electronic prescriptions. *Journal of the American Pharmacists Association*. 2009;**49**:59–64.
- 15 Gilligan AM, Miller K, Mohney A, Montenegro C, Schwarz J, Warholak TL. Analysis of pharmacists' interventions on electronic versus traditional prescriptions in 2 community pharmacies. *Research in Social & Administrative Pharmacy*. 2012;8:523–32.
- 16 CheungKC, vandenBemtPM, BouvyML, WensingM, De Smet PA. Medication incidents related to automated dose dispensing in community pharmacies

- and hospitals a reporting system study. *PLoS ONE*. 2014;**24**(9):e101686.
- 17 Larsen AB, Haugbølle LS. The impact of an automated dose-dispensing scheme on user compliance, medication understanding, and medication stockpiles. *Research in Social & Administrative Pharmacy*. 2007;3:265–84.
- **18** Hersberger KE, Boeni F, Arnet I. Dose-dispensing service as an intervention to improve adherence to polymedication. *Expert Review of Clinical Pharmacology*. 2013;**6**:413–21.
- **19** Sinnemäki J, Sihvo S, Isojärvi J, Blom M, Airaksinen M, Mäntylä A. Automated dose dispensing service for primary healthcare patients: a systematic review. *Systematic Reviews*. 2013;**2**:1–7.
- **20** Puspitasari HP, Aslani P, Krass I. A review of counseling practices on prescription medicines in community pharmacies. *Research in Social & Administrative Pharmacy.* 2009;**5**:197–210.
- **21** Kimberlin CL, Jamison AN, Linden S, Winterstein AG. Patient counseling practices in U.S. pharmacies: effects of having pharmacists hand the medication to the patient and state regulations on pharmacist counseling. *Journal of the American Pharmacists Association*. 2011;**51**:527–34.
- **22** Svarstad BL, Bultman DC, Mount JK, Tabak ER. Evaluation of written prescription information provided in community pharmacies: a study in eight states. *Journal of the American Pharmacists Association*. 2003:**43**:383–93.
- **23** Ax F, Brånstad JO, Westerlund T. Pharmacy counseling models: a means to improve drug use. *Journal of Clinical Pharmacy & Therapeutics*. 2010;**35**:439–51.
- 24 Elliott R, Boyd M, Waring J, Barber N, Mehta R, Chuter A, et al. Understanding and Appraising the New Medicines Service in the NHS in England. Available from: http://www.nottingham.ac.uk/~pazmjb/nms/downloads/report/files/assets/basic-html/index.html#1 (last accessed 18 November 2015).
- 25 World Health Organization. The Role of the Pharmacist in Self-Care and Self-Medication. Available from: http://apps.who.int/medicine-docs/pdf/whozip32e/whozip32e.pdf (last accessed 18 November 2015).
- **26** World Health Organization. Good Pharmacy Practice (GPP) in Community and Hospital Pharmacy Settings. Available from: http://apps.who.int/

- medicinedocs/documents/s21088en/s21088en.pdf (last accessed 18 November 2015).
- **27** Cavaco AM, Pereira PF. Pharmacists' counseling protocols for minor ailments: a structure-based analysis. *Research in Social & Administrative Pharmacy*. 2012:**8**:87–100.
- 28 Pharmaceutical Society of Australia. Standards for the Provision of Pharmacy Medicines and Pharmacist Only Medicines in Community Pharmacy. Revised, November 2005. Available from: http://www.psa.org.au/download/standards/s2s3-standards.pdf (last accessed 18 November 2015).
- 29 Royal Pharmaceutical Society of Great Britain. Over the counter (OTC) medicines. Available from: http:// www.rpharms.com/community-pharmacy-hub/ over-the-counter-medicines.asp (last accessed 18 November 2015).
- **30** Williams KA, Emmerton LM, Taylor R, Werner J, Benrimoj SI. Non-prescription medicines and Australian community pharmacy interventions: rates and clinical significance. *International Journal of Pharmacy Practice*. 2011;**19**:156–65.
- **31** Westerlund T, Marklund BRG, Handl WHA, Thunberg ME, Allebeck P. Nonprescription Drug-Related Problems and Pharmacy Interventions. *Annals of Pharmacotherapy*. 2001;**35**:1343–9.
- **32** Westerlund T, Allebeck P, Marklund B, Andersson IL, Brånstad JO, Sjöblom M. Evaluation of a model for counseling patients with dyspepsia in Swedish community pharmacies. *American Journal of Health-System Pharmacy*. 2003;**60**:1336–41.
- 33 Mehuys E, Van Bortel L, De Bolle L, Van Tongelen I, Remon JP, De Looze D. Self-medication of upper gastrointestinal symptoms: a community pharmacy study. *Annals of Pharmacotherapy*. 2009;43(5):890–8.
- **34** Krishnan HS, Schaefer M. Evaluation of the impact of pharmacist's advice giving on the outcomes of self-medication in patients suffering from dyspepsia. *Pharmacy World & Science*. 2000;**22**:102–8.
- 35 Eickhoff C, Hämmerlein A, Griese N, Schulz M. Nature and frequency of drug-related problems in self-medication (over-the-counter drugs) in daily community pharmacy practice in Germany. *Pharmacoepidemiology & Drug Safety*. 2012;21:254–60.
- **36** Frøkjær B, Bolvig T, Griese N, Herborg H, Rossing C. Prevalence of drug-related problems in self-medication in Danish community pharmacies. *Pharmacy Practice*. 2012;**3**:1–10.

- **37** Watson MC, Hart J, Johnston M, Bond CM. Exploring the supply of non-prescription medicines from community pharmacies in Scotland. *Pharmacy World & Science*. 2008;**30**:526–35.
- 38 Benrimoj SI, Gilbert AL, de Almeida Neto AC, Kelly F. National implementation of standards of practice for non-prescription medicines in Australia. *Pharmacy World & Science*. 2009;31:230–7.
- Smith F. The quality of private pharmacy services in low and middle-income countries: a systematic review. *Pharmacy World & Science*. 2009;**31**:351–61.
- Hepler CD, Strand LM. Opportunities and responsibilities in pharmaceutical care. *American Journal of Hospital Pharmacy*, 1990; **47**:533–43.
- Institute of Medicine. *To Err Is Human: Building a Safer Health System*. Washington, DC, National Academy Press, 2000.
- **42** Hepler CD. Clinical pharmacy, pharmaceutical care, and the quality of drug therapy. *Pharmacotherapy*. 2004;**24**:1491–8.
- **43** Allemann SS, van Mil JW, Botermann L, Berger K, Griese N, Hersberger KE. Pharmaceutical care: the PCNE definition 2013. *International Journal of Clinical Pharmacy*. 2014;**36**:544–55.
- Strand LM, Cipolle RJ, Morley PC, Frakes MJ. The impact of pharmaceutical care practice on the practitioner and the patient in the ambulatory practice setting: twenty-five years of experience. *Current Pharmaceutical Design*. 2006;**10**:3987–2001.
- de Castro MS, Correr CJ. Pharmaceutical care in community pharmacies: practice and research in Brazil. *Annals of Pharmacotherapy*. 2007;**41**:1486–93.
- Jones EJ, Mackinnon NJ, Tsuyuki RT. Pharmaceutical care in community pharmacies: practice and research in Canada. *Annals of Pharmacotherapy*. 2005;**39**:1527–33.
- Herborg H, Sørensen EW, Frøkjaer B. Pharmaceutical care in community pharmacies: practice and research in Denmark. *Annals of Pharmacotherapy*. 2007;**41**:681–9.
- Volmer D, Vendla K, Vetka A, Bell JS, Hamilton D. Pharmaceutical care in community pharmacies: practice and research in Estonia. *Annals of Pharmacotherapy*. 2008;**42**:1104–11.
- Benrimoj SI, Roberts AS. Providing patient care in community pharmacies in Australia. *Annals of Pharmacotherapy*. 2005;**39**:1911–17.

- Gastelurrutia MA, Faus MJ, Fernández-Llimós F. Providing patient care in community pharmacies in Spain. *Annals of Pharmacotherapy*. 2005;**39**:2105–10.
- Bell JS, Väänänen M, Ovaskainen H, Närhi U, Airaksinen MS. Providing patient care in community pharmacies: practice and research in Finland. *Annals of Pharmacotherapy*. 2007;**41**:1039–46.
- Noyce PR. Providing patient care through community pharmacies in the UK: policy, practice, and research. *Annals of Pharmacotherapy*. 2007;**41**:861–8.
- Eickhoff C, Schulz M. Pharmaceutical care in community pharmacies: practice and research in Germany. *Annals of Pharmacotherapy*. 2006;**40**:729–35.
- Alvarez-Risco A, van Mil JW. Pharmaceutical care in community pharmacies: practice and research in Peru. *Annals of Pharmacotherapy*. 2007;**41**:2032–7.
- 55 Westerlund LT, Björk HT. Pharmaceutical care in community pharmacies: practice and research in Sweden. *Annals of Pharmacotherapy*. 2006;40:1162–9.
- Christensen DB, Farris KB. Pharmaceutical care in community pharmacies: practice and research in the US. *Annals of Pharmacotherapy*. 2006;**40**:1400–6.
- van Mil JW. Pharmaceutical care in community pharmacy: practice and research in the Netherlands. *Annals of Pharmacotherapy*. 2005;**39**:1720–5.
- 58 Chisholm-Burns MA, Kim Lee J, Spivey CA, Slack M, Herrier RN, Hall-Lipsy E, et al. US pharmacists' effect as team members on patient care: systematic review and meta-analysis. *Medical Care*. 2010;48:923–33.
- 59 Abraham I, Palmer J, Martin JR, Kramer SS, Wunz T. US pharmacists' effect as team members on patient care: systematic review and meta-analysis. *Medical Care*. 2010;48:923–33.
- **60** Blalock SJ, Roberts AW, Lauffenburger JC, Thompson T, O'Connor SK. The effect of community pharmacy-based interventions on patient health outcomes: a systematic review. *Medical Care Research & Review.* 2013;**70**:235–66.
- Kaboli PJ, Hoth AB, McClimon BJ, Schnipper JL. Clinical pharmacists and inpatient medical care: a systematic review. *Archives of Internal Medicine*. 2006;**166**:955–64.
- Van Wijk B, Klugel O, Heerdink E, de Boer A. Effectiveness of interventions by community pharmacists to improve patient adherence to chronic medi-

- cation: a systematic review. *Annals of Pharmacotherapy*. 2005;**39**:319–28.
- **63** Nkansah N, Mostovetsky O, Yu C, Chheng T, Beney J, Bond CM, Bero L. Effect of outpatient pharmacists' non-dispensing roles on patient outcomes and prescribing patterns. *Cochrane Database of Systematic Reviews*. 2010;**7**:CD000336.
- **64** George J, Elliott RA, Stewart DC. A systematic review of interventions to improve medication taking in elderly patients prescribed multiple medications. *Drugs & Aging*. 2008;**25**:307–24.
- **65** Graabaek T, Kjeldsen LJ. Medication reviews by clinical pharmacists at hospitals lead to improved patient outcomes: a systematic review. *Basic & Clinical Pharmacology & Toxicology*. 2013;**112**:359−73.
- **66** Hanlon JT, Lindblad CI, Gray SL. Can clinical pharmacy services have a positive impact on drug-related problems and health outcomes in community-based older adults? *American Journal of Geriatric Pharmacotherapy.* 2004;**2**:3–13.
- **67** Wubben DP, Vivian EM. Effects of pharmacist outpatient interventions on adults with diabetes mellitus: a systematic review. *Pharmacotherapy*. 2008:**28**:421–36.
- **68** Aguiar PM, Balisa-Rocha BJ, Brito GC, da Silva WB, Machado M, Lyra DP Jr. Pharmaceutical care in hypertensive patients: a systematic literature review. *Research in Social & Administrative Pharmacy*. 2012;**8**(5):383−96.
- **69** Machado M, Bajcar J, Guzzo G, Einarson TR. Sensitivity of patient outcomes to pharmacist interventions. Part II: systematic review and meta-analysis in hypertension management. *Annals of Pharmacotherapy*. 2007;**41**:1770–81.
- **70** Altowaijri A, Phillips CJ, Fitzsimmons D. A systematic review of the clinical and economic effectiveness of clinical pharmacist intervention in secondary prevention of cardiovascular disease. *Journal of Managed Care Pharmacy*. 2013;**19**:408–16.
- **71** Evans CD, Watson E, Eurich DT, Taylor JG, Yakiwchuk EM, Shevchuk YM, et al. Diabetes and cardiovascular disease interventions by community pharmacists: a systematic review. *Annals of Pharmacotherapy*. 2011;**45**:615–28.
- **72** Santschi V, Chiolero A, Paradis G, Colosimo AL, Burnand B. Pharmacist interventions to improve cardiovascular disease risk factors in diabetes: a systematic review and meta-analysis

- of randomized controlled trials. *Diabetes Care*. 2012:**35**:2706–17.
- 73 Ponniah A, Anderson B, Shakib S, Doecke CJ, Angley M. Pharmacists' role in the post-discharge management of patients with heart failure: a literature review. *Journal of Clinical Pharmacy & Therapeutics*. 2007:32:343–52.
- **74** Elias MN, Burden AM, Cadarette SM. The impact of pharmacist interventions on osteoporosis management: a systematic review. *Osteoporosis International*. 2011;**22**:2587–96.
- 75 Bennett MI, Bagnall AM, Raine G, Closs SJ, Blenkinsopp A, Dickman A, Ellershaw J. Educational interventions by pharmacists to patients with chronic pain: systematic review and meta-analysis. *Clinical Journal of Pain*. 2011;27:623–30.
- 76 Charrois TL, Zolezzi M, Koshman SL, Pearson G, Makowsky M, Durec T, et al. A systematic review of the evidence for pharmacist care of patients with dyslipidemia. *Pharmacotherapy*. 2012;32: 222–33.
- 77 Rubio-Valera M, Serrano-Blanco A, Magdalena-Belio J, Fernández A, García-Campayo J, Pujol MM, del Hoyo YL. Effectiveness of pharmacist care in the improvement of adherence to antidepressants: a systematic review and meta-analysis. *Annals of Pharmacotherapy*. 2011;45:39–48.
- 78 Bell S, McLachlan AJ, Aslani P, Whitehead P, Chen TF. Community pharmacy services to optimise the use of medications for mental illness: a systematic review. *Australia & New Zealand Health Policy*. 2005:7:29.
- **79** von Gunten V, Reymond JP, Beney J. Clinical and economic outcomes of pharmaceutical services related to antibiotic use: a literature review. *Pharmacy World & Science*. 2007:**29**:146–63.
- **80** Cranor CW, Christensen DB. The Asheville Project: short-term outcomes of a community pharmacy diabetes care program. *Journal of the American Pharmacists Association*. 2003;**43**:149–59.
- **81** Cranor CW, Bunting BA, Christensen DB. The Asheville Project: long-term clinical and economic outcomes of a community pharmacy diabetes care program. *Journal of the American Pharmacists Association*. 2003;**43**:173–84.
- **82** Curtiss FR, Fry RN, Avey SG. Framework for pharmacy services quality improvement a bridge to cross the quality chasm. Part I. The opportunity

- and the tool. *Journal of Managed Care Pharmacy*. 2004:**10**:60–78.
- **83** Obreli-Neto PR, Guidoni CM, de Oliveira Baldoni A, Pilger D, Cruciol-Souza JM, Gaeti-Franco WP, Cuman RK. Effect of a 36-month pharmaceutical care program on pharmacotherapy adherence in elderly diabetic and hypertensive patients. *International Journal of Clinical Pharmacy*. 2011;**33**:642–9.
- **84** Herborg H, Soendergaard B, Jorgensen T, Fonnesbaek L, Hepler CD, Holst H, Froekjaer B. Improving drug therapy for patients with asthma part 2: use of antiasthma medications. *Journal of the American Pharmacists Association*. 2001;**41**:551–9.
- **85** Herborg H, Soendergaard B, Froekjaer B, Fonnesbaek L, Jorgensen T, Hepler CD, et al. Improving drug therapy for patients with asthma part 1: patient outcomes. *Journal of the American Pharmacists Association*. 2001:**41**:539–50.
- **86** Søndergaard B, Thorleifsson S, Herborg H, Frøkjaer B, Hepler CD, Ersbøll BK. [Quality assurance of drug therapy for patients with asthma. Health economic analysis.] *Ugeskrift for Laeger* 2000;**162**:480–6.
- **87** Schulz M, Verheyen F, Mühlig S, Müller JM, Mühlbauer K, Knop-Schneickert E, et al. Pharmaceutical care services for asthma patients: a controlled intervention study. *Journal of Clinical Pharmacology*. 2001;**41**:668–76.
- **88** Mangiapane S, Schulz M, Mühlig S, Ihle P, Schubert I, Waldmann HC. Community pharmacy-based pharmaceutical care for asthma patients. *Annals of Pharmacotherapy*. 2005;**39**:1817–22.
- **89** Castelino RL, Bajorek BV, Chen TF. Retrospective evaluation of home medicines review by pharmacists in older Australian patients using the medication appropriateness index. *Annals of Pharmacotherapy*. 2010;**44**:1922–9.
- **90.** Kwint HF, Faber A, Gussekloo J, Bouvy ML. The contribution of patient interviews to the identification of drug-related problems in home medication review. *Journal of Clinical Pharmacy and Therapeutics* 2012;37:674–80
- **91** Donabedian A. The quality of care: how can it be assessed? *Journal of the American Medical Association*. 1988:**260**:1743–8.
- **92** Kozma CM, Reeder CE, Schulz RM. Economic, clinical and humanistic outcomes: a planning tool for pharmacoeconomic research. *Clinical Therapeutics*. 1993;**15**:1121–32.

- 93 Danish Community Pharmacy Evidence Database. Evidence Reports. Available from: http://www.pharmakon.dk/pages/international.aspx?pageid=149 (last accessed 18 November 2015).
- **94** Mainz J. Defining and classifying clinical indicators for quality improvement. *International Journal for Quality in Health Care*. 2003;**15**:523–30.
- **95** Lohr KN. Outcomes measurement: concepts and questions. *Inquiry*. 1988;**25**:37–50.
- **96** Hepler CD, Strand LM. Opportunities and responsibilities in pharmaceutical care. *American Journal of Hospital Pharmacy*. 1990;**47**:533–43.
- 97 van Mil JW, Westerlund LO, Hersberger KE, Schaefer MA. Drug-related problem classification systems. *Annals of Pharmacotherapy*. 2004;38: 859–67.
- **98** Basger BJ, Moles RJ, Chen TF. Application of drug-related problem (DRP) classification systems: a review of the literature. *European Journal of Clinical Pharmacology*. 2014;**70**:799–815.
- **99** van Mil F. Drug-related problems: a cornerstone for pharmaceutical care. *Journal of the Malta College of Pharmacy Practice*. 2005;**10**:5–8
- **100** Westerlund T, Gelin U, Pettersson E, Skärlund F, Wågström K, Ringbom C. A retrospective analysis of drug-related problems documented in a national database. *International Journal of Clinical Pharmacy*. 2013;**35**:202–9.
- 101 Fernández-Llimós F, Tuneu L, Baena MI, Garcia-Delgado A, Faus MJ. Morbidity and mortality associated with pharmacotherapy. Evolution and current concept of drug-related problems. *Current Pharmaceutical Design*. 2004;10:3947–67.
- 102 Krska J, Jamieson D, Arris F, McGuire A, Abbott S, Hansford D, Cromarty J. A classification system for issues identified in pharmaceutical care practice. *International Journal of Pharmacy Practice*. 2002;10:91–100.
- **103** Mackinnon NJ, Hepler CD. Preventable drug-related morbidity in older adults 1. Indicator development. *Journal of Managed Care Pharmacy*. 2002;**8**:365–71.
- 104 Morris CJ, Cantrill JA, Hepler CD, Noyce PR. Preventing drug-related morbidity determining valid indicators. *International Journal for Quality in Health Care*. 2002;14:183–98.
- **105** Robertson HA, MacKinnon NJ. Development of a list of consensus-approved clinical indicators

- of preventable drug-related morbidity in older adults. *Clinical Therapeutics*. 2002;**24**:1595–613.
- **106** Guerreiro MP, Cantrill JA, Martins AP. [Preventable drug-related morbidity: determining valid indicators for primary care in Portugal.] *Acta Médica Portuguesa*. 2007;**20**:107–29.
- **107** Morris C, Cantrill J. Preventable drug-related morbidity indicators in the US and UK. *Journal of Managed Care Pharmacy*. 2002;**8**:372–7.
- 108 Pereira Guerreiro M, Martins AP, Cantrill JA. Preventable drug-related morbidity in community pharmacy: development and piloting of a complex intervention. *International Journal of Clinical Pharmacy*. 2012;34:699–709.
- **109** Odedina FT, Segal R. Behavioral pharmaceutical care scale for measuring pharmacists' activities. *American Journal of Health-System Pharmacy*. 1996:**53**:855–65.
- **110** Hughes CM, Hawwa AF, Scullin C, Anderson C, Bernsten CB, Björnsdóttir I, et al. Provision of pharmaceutical care by community pharmacists: a comparison across Europe. *Pharmacy World & Science*. 2010;**32**:472−87.
- **111** Ward P, Bissell P, Noyce P. Criteria for assessing the appropriateness of patient counseling in community pharmacies. *Annals of Pharmacotherapy*. 2000;**34**:170–5.
- **112** Azzopardi LM. *Validation Instruments for Community Pharmacy.* London, Pharmaceutical Products Press, 2000.
- 113 Scicluna CA, Azzopardi LM, Serracino-Inglott
 A. Validation Instruments for Community Pharmacy.
 Malta, Lambert Academic Publishing, 2012.
- **114** Roberts MB, Keith MR. Implementing a performance evaluation system in a correctional managed care pharmacy. *American Journal of Health-System Pharmacy*. 2002;**59**:1097–104.
- 115 Curtiss FR, Fry RN, Avey SG. Framework for pharmacy services quality improvement a bridge to cross the quality chasm. Part I. The opportunity and the tool. *Journal of Managed Care Pharmacy*. 2004; 10:60–78.
- 116 Trap B, Hansen EH, Trap R, et al. A new indicator based tool for assessing and reporting on good pharmacy practice. *Southern Med Review*. 2010;3:4–11.
- **117** de Bie J, Kijlstra NB, Daemen BJG, Bouvy ML. The development of quality indicators for commu-

- nity pharmacy care. British Medical Journal Quality & Safety. 2011;**20**:666–71.
- 118 Naik Panvelkar P, Saini B, Armour C. Measurement of patient satisfaction with community pharmacy services: a review. *Pharmacy World & Science*. 2009;31:525–37.
- 119 Larson LN, Rovers JP, MacKeigan LD. Patient satisfaction with pharmaceutical care: update of a validated instrument. *Journal of the American Pharmacists Association*. 2002;**42**:44–50.
- **120** Horvat N, Kos M. Development and initial validation of a patient satisfaction with pharmacy performance questionnaire (PSPP-Q). *Evaluation & The Health Professions*. 2010;**33**:197–215.
- 121 Austrian Federal Ministry of Health. Understanding the Pharmaceutical Care Concept and Applying it in Practice. Available from: https://ppri.goeg.at/Downloads/Publications/Gesamt%20Publikation%20Understanding%20the%20Pharmaceutical%20Care%20Concept%20and%20Applying%20it%20in%20Practice.pdf (last accessed 18 November 2015).
- 122 European Directorate for the Quality of Medicines & HealthCare. Pharmaceutical Care: Policies and Practices for a Safer, More Responsible and Cost-effective Health System. Available from: https://www.edqm.eu/medias/fichiers/policies_and_practices_for_a_safer_more_responsibl.pdf (last accessed 18 November 2015).
- 123 Danish Institute for Quality and Accreditation in Healthcare (IKAS). Danish Healthcare Quality Programme (DDKM) Accreditation Standards for Community Pharmacies, 2nd Version. (March 2013–February 2017).
- 124 IGZ Health Care Inspectorate. KNMP Royal Dutch Association for the Advancement of Pharmacy. Quality Indicators for Pharmacies. Utrecht, September 2009.
- 125 Royal Pharmaceutical Society of Great Britain. Professional Standards for Hospital Pharmacy Services. Version 2, July 2014. Available from: http://www.rpharms.com/support-pdfs/rps--professional-standards-for-hospital-pharmacy.pdf (last accessed 18 November 2015).
- Professional Practice Standards Version 4,
 Pharmaceutical Society of Australia 2010. Available from: http://www.psa.org.au/download/

- standards/professional-practice-standards-v4.pdf (last accessed 18 November 2015).
- 127 Aitken M, Gorokhovich L. Advancing the responsible use of medicines. Applying levers for change. Available from: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2222541 (last accessed 18 November 2015).
- 128 Thomsen L, Frøkjær B, Rossing C, Herborg H. Assessment of Pharmacy Systems in Selected Countries Identification of Literature and Experience. Available from: http://europharm.pbworks.com/w/file/fetch/53213512/Assessment%20 of%20pharmacy%20systems_WEB_samlet.pdf (last accessed 18 November 2015).
- **129** American Society of Health-System Pharmacists. ASHP quality advocates influencing national

- quality measures. Available from: http://www.ashpintersections.org/2014/06/ashp-quality-advocates-influencing-national-quality-measures/ (last accessed 18 November 2015).
- 130 Svensk Farmaci. Läs LV:s förslag på apoteksindikatorer. Available from: http://svenskfarmaci.se/apotek/las-lvs-forslag-pa-apoteksindikatorer/ (last accessed 18 November 2015).
- 131 Läkemedelsvärket. Fem indikatorer ska jämföra apotekens kvalitet. Available from: http://www.lakemedelsvarlden.se/nyheter/fem-indikatorer-ska-jamfora-apotekens-kvalitet-12830 (last accessed 18 November 2015).
- **132** Tromp D. Flewowijk Pharmacy Annual Report 2003/2004.

- 1 Wang H, Dwyer-Lindgren L, Lofgren KT, Rajaratnam JK, Marcus JR, Levin-Rector A, et al. Age-specific and sex-specific mortality in 187 countries, 1970-2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet*. 2012;380(9859):2071–94.
- 2 Hallas J, Worm J, Beck-Nielsen J, Gram LF, Grodum E, Damsbo N, Brosen K. Drug related events and drug utilization in patients admitted to a geriatric hospital department. *Danish Medical Bulletin*. 1991;38(5):417–20.
- **3** Wilson RM, Runciman WB, Gibberd RW, Harrison BT, Newby L, Hamilton JD. The Quality in Australian Health Care Study. *Medical Journal of Australia*. 1995;**163**:458–71.
- **4** Lazarou J, Pomeranz BH, Corey PN. Incidence of adverse drug reactions in hospitalized patients: a meta-analysis of prospective studies. *Journal of the American Medical Association*. 1998;**279**:1200–5.
- 5 UK Department of Health. An Organisation with a Memory: Report of an Expert Group on Learning from Adverse Events in the NHS. Chaired by the Chief Medical Officer. Available from: https://www.aagbi.org/sites/default/files/An%20 organisation%20with%20a%20memory.pdf (last accessed 18 November 2015).
- **6** Kohn LT, Corrigan JM, Donaldson MS, eds. *To Err is Human: Building a Safer Health System.* Washington, DC, National Academy Press, 1999.
- **7** Pirmohamed M, James S, Meakin S, Green C, Scott AK, Walley TJ, et al. Adverse drug reactions as cause of admission to hospital: prospective analysis of 18 820 patients. *British Medical Journal*. 2004;**329**(7456):15–19.
- **8** Hilmer SN, Mager DE, Simonsick EM, Cao Y, Ling SM, Windham G, et al. A drug burden index to

- define the functional burden of medications in older people. *Archives of Internal Medicine*. 2007;**167**:781–7.
- **9** Australian Commission on Safety and Quality in Health Care. Literature Review: Medication Safety in Australia. Available from: http://www.safet-yandquality.gov.au/wp-content/uploads/2014/02/Literature-Review-Medication-Safety-in-Australia-2013.pdf (last accessed 18 November 2015).
- 10 Dukes MNG, ed. Drug Utilization Studies: Methods and Uses. Available from: http://apps.who.int/medicinedocs/documents/s21868en/s21868en.pdf (last accessed 18 November 2015).
- 11 Bergman U, Sjöqvist F. Measurement of drug utilization in Sweden: methodological and clinical implications. *Acta Medica Scandinavica*. 1984; Suppl. 683:15–22.
- 12 World Health Organization. Introduction to Drug Utilization Research. Available from: http://apps. who.int/medicinedocs/en/d/Js4876e/ (last accessed 18 November 2015).
- **13** Wensing M, van der WT, Grol R. Implementing guidelines and innovations in general practice: which interventions are effective? *British Journal of General Practice*. 1998;**48**(427):991–7.
- 14 Davis DA, Thomson M, Oxman AD, Haynes R. Changing Physician Performance: A Systematic Review of the Effect of Continuing Medical Education Strategies. *Journal of the American Medical Association*. 1995;274(9):700–5.
- **15** Eccles M, Mittman B. Welcome to Implementation Science [editorial]. *Implementation Science*. 2006;**1**:1.
- **16** Grimshaw JM, Thomas RE, MacLennan G, Fraser C, Ramsay CR, Vale L, et al. Effectiveness and efficiency of guideline dissemination and implementation strategies. *Health Technology Assessment*. 2004;**8**(6):iii–iv, 1–72.
- 17 Bloom BS. Effects of continuing medical education on improving physician clinical care and patient

- health: a review of systematic reviews. *International Journal of Technology Assessment in Health Care*. 2005;**21**(3):380–5.
- **18** O'Brien MA, Rogers S, Jamtvedt G, Oxman AD, Odgaard-Jensen J, Kristoffersen DT, et al. Educational outreach visits: effects on professional practice and health care outcomes. *Cochrane Database of Systematic Reviews.* **2007**;**4**:CD000409.
- 19 Ivers N, Jamtvedt G, Flottorp S, Young JM, Odgaard-Jensen J, French SD, et al. Audit and feedback: effects on professional practice and healthcare outcomes. *Cochrane Database of Systematic Reviews*. 2012:6:CD000259.
- **20** Squires JE, Sullivan K, Eccles MP, Worswick J, Grimshaw JM. Are multifaceted interventions more effective than single-component interventions in changing health-care professionals' behaviours? An overview of systematic reviews. *Implementation Science*. 2014;**9**:152.
- **21** Hrisos S, Eccles M, Johnston M, Francis J, Kaner EFS, Steen N, Grimshaw J. Developing the content of two behavioural interventions: using theory-based interventions to promote GP management of upper respiratory tract infection without prescribing antibiotics. *BMC Health Services Research*. 2008;**8**:11.
- **22** Ivers NM, Sales A, Colquhoun H, Michie S, Foy R, Francis JJ, Grimshaw JM. No more 'business as usual' with audit and feedback interventions: towards an agenda for a reinvigorated intervention. *Implementation Science*. 2014;**9**:14.
- **23** The Improved Clinical Effectiveness through Behavioural Research Group. Designing theoretically-informed implementation interventions. *Implementation Science*. **2006**;**1**(1):4.
- **24** Abraham C, Michie S. A taxonomy of behavior change techniques used in interventions. *Health Psychology*. 2008;**27**(3):379–87.
- **25** Schulz R, Czaja SJ, McKay JR, Ory MG, Belle SH. Intervention taxonomy (ITAX): describing essential features of interventions. *American Journal of Health Behavior*. 2010;**34**(6):811–21.
- **26** Michie S, Johnston M. Changing clinical behaviour by making guidelines specific. *British Medical Journal*. 2004:**328**:343–5.
- **27** Michie S, van Stralen MM, West R. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implementation Science*. 2011;**6**:42.

- 28 Michie S, Richardson M, Johnston M, Abraham C, Francis J, Hardeman W, et al. The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: building an international consensus for the reporting of behavior change interventions. *Annals of Behavioral Medicine*. 2013;46(1):81–95.
- 29 Colquhoun H, Leeman J, Michie S, Lokker C, Bragge P, Hempel S, et al. Towards a common terminology: a simplified framework of interventions to promote and integrate evidence into health practices, systems, and policies. *Implementation Science*. 2014;9:51. Erratum in: *Implementation Science*. 2014;9:154.
- 30 Cane J, Richardson M, Johnston M, Ladha R, Michie S. From lists of behaviour change techniques (BCTs) to structured hierarchies: comparison of two methods of developing a hierarchy of BCTs. *British Journal of Health Psychology*, 2015;20(1):130–50.
- 31 Cochrane Effective Practice and Organisation of Care Group. EPOC-specific resources for review authors. Available from: http://epoc.cochrane.org/epoc-specific-resources-review-authors (last accessed 18 November 2015).
- **32** Grigoryan L, Burgerhof JGM, Degener JE, Deschepper R, Lundborg CS, Monnet DL, et al. Determinants of self-medication with antibiotics in Europe: the impact of beliefs, country wealth and the healthcare system. *Journal of Antimicrobial Chemotherapy*. 2008;**61**(5):1172–9.
- **33** Godman B, Shrank W, Andersen M, Berg C, Bishop I, Burkhardt T, et al. Policies to enhance prescribing efficiency in europe: findings and future implications. *Frontiers in Pharmacology*. 2011;**1**:141.
- **34** Laing R, Hogerzeil H, Ross-Degnan D. Ten recommendations to improve use of medicines in developing countries. *Health Policy Planning*. 2001;**16**(1): 13–20.
- **35** Grimshaw JM, Shirran L, Thomas RE, Mowatt G, Fraser C, Bero L, et al. Changing provider behavior: an overview of systematic reviews of interventions. *Medical Care*. 2001;**39**:II2–45.
- **36** Ross S, Loke YK. Do educational interventions improve prescribing by medical students and junior doctors? A systematic review. *British Journal of Clinical Pharmacology*. 2009;**67**:662–70.
- **37** Ostini R, Hegney D, Jackson C, Williamson M, Mackson JM, Gurman K, et al. Systematic Review

- of interventions to improve prescribing. *Annals of Pharmacotherapy*. 2009;**43**(3):502–13.
- **38** Brennan N, Mattick K. A systematic review of educational interventions to change behaviour of prescribers in hospital settings, with a particular emphasis on new prescribers. *British Journal of Clinical Pharmacology*. 2012;**75**(2):359–72.
- **39** Grol R, Wensing M, Eccles M, eds. *Improving Patient Care: The Implementation of Change in Clinical Practice*. Oxford, Elsevier, 2005.
- **40** Wettermark B, Godman B, Jacobsson B, Haaijer-Ruskamp F. Soft regulations in pharmaceutical policymaking an overview of current approaches and their consequences. *Applied Health Economics and Health Policy*. 2009;**7**:137–47.
- **41** Canadian Agency for Drugs and Technology in Health. Rx for Change Interventions Database. Available from: https://www.cadth.ca/rx-change (last accessed 18 November 2015).
- **42** Grol R. Beliefs and evidence in changing clinical practice. *British Medical Journal*. 1997;**315**:418–21.
- **43** Hunt G, Barker JC. Drug treatment in contemporary anthropology and sociology. *European Addiction Research*. 1999;**5**(3):126–32.
- **44** Effective Practice and Organisation of Care. EPOC Taxonomy. Available from: https://epoc.cochrane.org/epoc-taxonomy (last accessed 18 November 2015).
- **45** Figueiras A, Sastre I, Gestal-Otero JJ. Effectiveness of educational interventions on the improvement of drug prescription in primary care: a critical literature review. *Journal of Evaluation in Clinical Practice*. 2001;**7**(2):223–41.
- **46** Davey P, Brown E, Charani E, Fenelon L, Gould IM, Holmes A, et al. Interventions to improve antibiotic prescribing practices for hospital inpatients. *Cochrane Database of Systematic Reviews*. 2013:**4**:CD003543.
- 47 Giguère A, Légaré F, Grimshaw J, Turcotte S, Fiander M, Grudniewicz A, et al. Printed educational materials: effects on professional practice and healthcare outcomes. *Cochrane Database of Systematic Reviews*. 2012;10:CD004398.
- **48** Zwarenstein M, Shiller SK, Croxford R, Grimshaw JM, Kelsall D, Paterson JM, et al. Printed educational messages aimed at family practitioners fail to increase retinal screening among their patients with diabetes: a pragmatic cluster randomized controlled trial. *Implementation Science*. **2014**;**9**:87.

- **49** Ivers NM, Grimsham JM, Jamtvedt G, Flottorp S, O'Brien MA, French SD, et al. Growing literature, stagnant science? Systematic review, meta-regression and cumulative analysis of audit and feedback interventions in health care. *Journal of General Internal Medicine*. **2014**;**29**(11):1534–41.
- 50 Søndergaard J, Andersen M, Kragstrup J, Hansen P, Freng Gram L. Why has postal prescriber feedback no substantial impact on general practitioners' prescribing practice? A qualitative study. *European Journal of Clinical Pharmacology*. 2002;58(2):133–6.
- 51 Schroll H, Christensen RD, Thomsen JL, Andersen M, Friborg S, Søndergaard J. The Danish model for improvement of diabetes care in general practice: impact of automated collection and feedback of patient data. *International Journal of Family Medicine*. 2012;2012:208123.
- **52** O'Connel DL, Henry D, Tomson G. Randomised controlled trial of effect of feedback on general practitioners prescribing in Australia. *British Medical Journal*. 1999;**318**:507–11.
- **53** Roughead E, Pratt N, Peck R, Gilbert A. Improving medication safety: influence of a patient-specific prescriber feedback program on rate of medication reviews performed by Australian general medical practitioners. *Pharmacoepidemiology & Drug Safety*. 2007;**16**(7):797–803.
- **54** Balas EA, Weingarten S, Garb CT, Blumenthal D, Boren SA, Brown GD. Improving preventive care by prompting physicians. *Archives of Internal Medicine*. 2000;**160**(3):301–8.
- 55 Buntinx F, Winkens R, Grol R, Knottnerus JA. Influencing diagnostic and preventive performance in ambulatory care by feedback and reminders. A review. *Family Practice*. 1993;10(2):219–28.
- 56 Kawamoto K, Houlihan CA, Balas EA, Lobach DF. Improving clinical practice using clinical decision support systems: a systematic review of trials to identify features critical to success. *British Medical Journal*. 2005;330(7494):765.
- **57** Mandelblatt J, Kanetsky PA. Effectiveness of interventions to enhance physician screening for breast cancer. *Journal of Family Practice*. 1995;**40**(2):162–71.
- **58** Shea S, DuMouchel W, Bahamonde L. A meta-analysis of 16 randomized controlled trials to evaluate computer-based clinical reminder systems for preventive care in the ambulatory setting. *Jour-*

- nal of the American Medical Information Association. 1996;3(6):399–409.
- **59** Wensing M, Grol R. Single and combined strategies for implementing changes in primary care: a literature review. *International Journal for Quality in Health Care.* 1994;**6**(2):115–32.
- 60 Moja L, Kwag KH, Lytras T, Bertizzolo L, Brandt L, Pecoraro V, et al. Effectiveness of computerized decision support systems linked to electronic health records: a systematic review and meta-analysis. *American Journal of Public Health*. 2014;104(12):e12–22.
- **61** Avorn J, Soumerai SB. Improving drug-therapy decisions through educational outreach. A randomized controlled trial of academically based 'detailing'. *New England Journal of Medicine*. 1983;**308**(24):1457–63.
- **62** Soumerai SB, Avorn J. Principles of educational outreach ('academic detailing') to improve clinical decision making. *Journal of the American Medical Association*. 1990;**263**(4):549–56.
- **63** Scott I. Errors in clinical reasoning: causes and remedial strategies. *British Medical Journal*. 2009;**338**:b1860.
- **64** Croskerry P, Singhal G, Mamede S. Cognitive debiasing 2: impediments to and strategies for change. *British Medical Journal Quality & Safety.* 2013;**22**:ii65–72.
- 65 Kotler P. Marketing for Nonprofit Organizations. Englewood Cliffs, NJ, Prentice-Hall, 1975.
- 66 Andreasen AR. Marketing Social Change: Changing Behavior to Promote Health, Social Development and the Environment. San Francisco, CA, Jossey-Bass, 1995.
- **67** May F, Simpson D, Hart L, Rowett D, Perrier D. Experience with academic detailing services for quality improvement in primary care practice. *Quality & Safety in Health Care*. 2009;**18**(3):225–31.
- **68** Pond CD, Mant A, Kehoe L, Hewitt H, Brodaty H. General practitioner diagnosis of depression and dementia in the elderly: can academic detailing make a difference? *Family Practice*. 1994;**11**(2):141–7.
- **69** Allen M, Ferrier S, O'Connor N, Fleming I. Family physicians' perceptions of academic detailing: a quantitative and qualitative study. *BMC Medical Education*. 2007;**7**:36.
- **70** May FW, Rowett DS, Gilbert AL, McNeece JI, Hurley E. Outcomes of an educational-outreach ser-

- vice for community medical practitioners: non-steroidal anti-inflammatory drugs. *Medical Journal of Australia*. 1999;**170**:471–4.
- 71 Freemantle N, Nazareth I, Eccles M, Wood J, Haines A. A randomised controlled trial of the effect of educational outreach by community pharmacists on prescribing in UK general practice. *British Journal of General Practice*. 2002;**52**(477):290–5.
- **72** Jin M, Naumann T, Regier L, Bugden S, Allen M, Salach L, et al. A brief overview of academic detailing in Canada: another role for pharmacists. *Canadian Pharmacists Journal*. 2012;**145**(3):142–6.
- 73 Granados A, Jonsson E, Banta HD, Bero L, Bonair A, Cochet C, et al. EUR ASSESS Project subgroup report on dissemination and impact. *International Journal of Technology Assessment in Health Care*. 1997;13(2):220–86.
- **74** Mason J, Freemantle N, Nazareth I, Eccles M, Haines A, Drummond M. When is it cost-effective to change the behavior of health professionals? *Journal of the American Medical Association*. 2001;**286**(23):2988–92.
- **75** Soumerai SB, Avorn J. Economic and policy analysis of university-based drug 'detailing'. *Medical Care*. 1986;**24**(4):313–31.
- **76** Naughton C, Feely J, Bennett K. A RCT evaluating the effectiveness and cost-effectiveness of academic detailing versus postal prescribing feedback in changing GP antibiotic prescribing. *Journal of Evaluation in Clinical Practice*. 2009;**15**(5):807–12.
- 77 World Health Organization. Guide to Good Prescribing: A Practical Manual. Available from: http://apps.who.int/medicinedocs/pdf/whozip23e/whozip23e.pdf (last accessed 18 November 2015).
- **78** Kamarudin G, Penm J, Chaar B, Moles R. Educational interventions to improve prescribing competency: a systematic review. *British Medical Journal Open.* 2013;**3**(8):e003291.
- 79 National Prescribing Service. Competencies Required to Prescribe Medicines: Putting Quality Use of Medicines into Practice. Available from: http://www.nps.org.au/__data/assets/pdf_file/0004/149719/Prescribing_Competencies_Framework.pdf (last accessed 18 November 2015).
- **80** Lum E, Mitchell C, Coombes I. The competent prescriber: 12 core competencies for safe prescribing. *Australian Prescriber*. 2013;**36**:13–16.
- **81** Spinewine A, Schmader KE, Barber N, Hughes C, Lapane KL, Swine C, Hanlon JT.

- Appropriate prescribing in elderly people: how well can it be measured and optimised? *Lancet*. 2007;**370**(9582):173–84.
- **82** Denig P, Haaijer-Ruskamp FM, Zijsling DH. How physicians choose drugs. *Social Science & Medicine*. 1988;**27**(12):1381−6.
- **83** Rothwell C, Burford B, Morrison J, Morrow G, Allen M, Davies C, et al. Junior doctors prescribing: enhancing their learning in practice. *British Journal of Clinical Pharmacology*. 2012;**73**(2):194–202.
- **84** Schwartz RK, Soumerai SB, Avorn J. Physician motivations for nonscientific drug prescribing. *Social Science & Medicine*. 1989;**28**(6):577–82.
- **85** Barber N. What constitutes good prescribing? *British Medical Journal*. 1995;**310**:923–5.
- **86** Robertson N, Baker R, Hearnshaw H. Changing the clinical behaviour of doctors: a psychological framework. *Quality in Health Care*. 1995;**5**:51–4.
- **87** Guthrie B, Payne K, Alderson P, McMurdo ME, Mercer SW. Adapting clinical guidelines to take account of multimorbidity *British Medical Journal*. 2012:**345**:e6341.
- **88** Barnett K, Mercer SW, Norbury M, Watt G, Wyke S, Guthrie B. Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. *Lancet*. 2012;**380**:37–43.

- **89** Dumbreck S, Flynn A, Nairn M, Wilson, Treweek S, Mercer, et al. Drug-disease and drug-drug interactions: systematic examination of recommendations in 12 UK national clinical guidelines. *British Medical Journal*. 2015;**350**:h949.
- **90** Knight A. Patient-centred prescribing. *Australian Prescriber*. 2013;**36**:199–201.
- **91** Sinnott SJ, Buckley C, O'Riordan D, Bradley C, Whelton H. The effect of copayments for prescriptions on adherence to prescription medicines in publicly insured populations; a systematic review and meta-analysis. *PLoS ONE*. 2013;**8**(5):e64914.
- **92** Bennie M, Godman B, Bishop I, Campbell S. Multiple initiatives continue to enhance the prescribing efficiency for the proton pump inhibitors and statins in Scotland. *Expert Review of Pharmacoeconomics & Outcomes Research.* 2012;**12**(1):125–30.
- **93** Bjerrum L, Munck A, Gahrn-Hansen B, Hansen MP, Jarbol DE, Cordoba G, et al. Health Alliance for prudent antibiotic prescribing in patients with respiratory tract infections (HAPPY AUDIT) impact of a non-randomised multifaceted intervention programme. *BMC Family Practice*. 2011;**12**:52.
- **94** Pedersen KM, Andersen JS, Søndergaard J. General practice and primary health care in Denmark. *Journal of the American Board of Family Medicine*. 2012;**25**(Suppl. 1):S34–8.

- 1 Grimshaw J, McAuley LM, Bero LA, Grilli R, Oxman AD, Ramsay C, et al. Systematic reviews of the effectiveness of quality improvement strategies and programmes. *Quality & Safety in Health Care*. 2003;12(4):298–303.
- **2** Grimshaw JM, Shirran L, Thomas R, Mowatt G, Fraser C, Bero L, et al. Changing provider behavior: an overview of systematic reviews of interventions. *Medical Care*. 2001;**39**(8 Suppl. 2):II2–45.
- **3** Jamtvedt G, Young JM, Kristoffersen DT, O'Brien MA, Oxman AD. Does telling people what they have been doing change what they do? A systematic review of the effects of audit and feedback. *Quality & Safety in Health Care*. 2006;**15**(6):433–6.
- **4** Jamtvedt G, Young JM, Kristoffersen DT, O'Brien MA, Oxman AD. Audit and feedback: Effects on professional practice and health care outcomes. *Cochrane Database of Systematic Reviews*. 2006;**2**:CD000259.
- 5 Hill-Taylor B, Sketris I, Hayden J, Byrne S, O'Sullivan D, Christie R. Application of the STOPP/START criteria: a systematic review of the prevalence of potentially inappropriate prescribing in older adults, and evidence of clinical, humanistic and economic impact. *Journal of Clinical Pharmacy and Therapeutics*. 2013;38(5):360–72.
- **6** Holloway KA, Ivanovska V, Wagner AK, Vialle-Valentin C, Ross-Degnan D. Have we improved use of medicines in developing and transitional countries and do we know how to? Two decades of evidence. *Tropical Medicine & International Health*. 2013;**18**(6):656–64.
- **7** Tjia J, Velten SJ, Parsons C, Valluri S, Briesacher BA. Studies to reduce unnecessary medication use in frail older adults: a systematic review. *Drugs & Aging*. 2013;**30**(5):285–307.

- **8** Eccles M, Grimshaw J, Walker A, Johnston M, Pitts N. Changing the behavior of healthcare professionals: the use of theory in promoting the uptake of research findings. *Journal of Clinical Epidemiology*. 2005;**58**(2):107–12.
- **9** Roughead EE. Enhancing early uptake of drug evidence into primary care. *Expert Review of Pharmacoeconomics & Outcomes Research.* 2006;**6**:661–71.
- 10 Green LW, Kreuter MW. Health Program Planning: An Educational and Ecological Approach, 4th edn. New York, McGraw Hill, 1995.
- 11 Bandura A. *Social Foundations of Thought and Action: A Social Cognitive Theory.* Englewood Cliffs, NJ, Prentice-Hall, 1986.
- 12 Bandura A. Human agency in social cognitive theory. American Psychology. 1989;44:1175–84.
- 13 Prochaska JO, Di Clemente CO. Towards a comprehensive model of change. In: Miller WR, Heather N, eds. *Treating Addictive Behaviours: Processes of Change.* New York, Plenum Press, 1986: 3–27.
- **14** Prochaska JO, Velicer WF. The transtheoretical model of health behaviour change. *American Journal of Health Promotion*. 1997;**12**(1):38–48.
- **15** Prochaska JO, Velicer WF, Rossi JS, Goldstein MG, Marcus BH, Rakowski W, et al. Stages of change and decisional balance for 12 problem behaviours. *Health Psychology.* 1994;**13**:39–46.
- **16** Cialdini RB. *Influence: Science and Practice*, 3rd edn. New York, HarperCollins College, 1993.
- **17** Berry D. *Health Communication Theory and Practice*. New York, McGraw-Hill Education, 2006.
- **18** French J, Merritt R, Reynolds L. *Social Marketing Casebook*. London, SAGE Publications, 2011.
- 19 Lee N, Kotler P. Social Marketing: Influencing Behaviors for Good, 4th edn. Thousand Oaks, CA, SAGE Publications, 2011.
- **20** Green LW, Kreuter MW. CDC's planned approach to community health as an application of PRECEDE

- and an inspiration for PROCEED. *Journal of Health Education*. 1992;**23**:140–7.
- 21 Berwick DM. Disseminating innovations in health care. *Journal of the American Medical Association*. 2003:289(15):1969–75.
- **22** Glanz K, Rimer BK, Viswanath K. *Health Behavior and Health Education Theory, Research, and Practice*, 4th edn. San Francisco, CA, Jossey-Bass, 2008.
- **23** Winett RA. A framework for health promotion and disease prevention programs. *American Psychology*. 1995;**50**:341–50.
- **24** Winett RA, King AC, Altman DG. *Health Psychology* and *Public Health: An Integrative Approach*. New York, Pergamon Press, 1989.
- 25 Cancer Council Australia. Effective interventions. Available from: http://wiki.cancer.org.au/prevention/Tobacco_control/Effective_interventions (last accessed 18 November 2015).
- **26** Fishbein M, Ajzen I. *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research.* Reading, MA, Addison-Wesley, 1975.
- **27** Ajzen I. From intentions to actions: a theory of planned behavior. In: Kuhl J, Beckman J, eds. *Action Control: From Cognition to Behavior.* Heidelberg, Springer, 1985: 11–39.
- 28 Rotter JB. Social Learning and Clinical Psychology. New York, Prentice Hall, 1954.
- **29** Rotter JB. Generalized expectancies for internal versus external control of reinforcement. *Psychology Monograhs*. 1966;**80**(1):1–28.
- **30** Cipolle J, Strand L, Morley P. *Pharmaceutical Care Practice: The Clinician's Guide.* New York, McGraw Hill. 2004.
- 31 Someria SB. Factors influencing prescribing. Australian Journal of Hospital Pharmacy. 1988;18(Suppl.): 9–16
- **32** Roughead E. Report on the National Indicators; Evaluating the Quality Use of Medicines Component of Australia's National Medicines Policy. Commonwealth of Australia, 1999.
- 33 Dollman WB, Leblanc VT, Stevens L, O'Connor PJ, Roughead EE, Gilbert AL. Achieving a sustained reduction in benzodiazepine use through implementation of an area-wide multi-strategic approach. *Journal of Clinical Pharmacy and Therapeutics*. 2005;30(5):425–32.
- **34** Farmer AP, Legare F, Turcot L, Grimshaw J, Harvey E, McGowan JL, et al. Printed educational materials:

- effects on professional practice and health care outcomes. *Cochrane Database of Systematic Reviews*. 2008;**3**:CD004398.
- **35** Giguere A, Legare F, Grimshaw J, Turcotte S, Fiander M, Grudniewicz A, et al. Printed educational materials: effects on professional practice and healthcare outcomes. *Cochrane Database of Systematic Reviews*. 2012;**10**:CD004398.
- **36** Piening S, Haaijer-Ruskamp FM, de Vries JT, van der Elst ME, de Graeff PA, Straus SM, et al. Impact of safety-related regulatory action on clinical practice: a systematic review. *Drug Safety*. 2012;**35**(5):373–85.
- **37** Dusetzina SB, Higashi AS, Dorsey ER, Conti R, Huskamp HA, Zhu S, et al. Impact of FDA drug risk communications on health care utilization and health behaviors: a systematic review. *Medical Care*. 2012;**50**(6):466–78.
- 38 Garg V, Raisch DW, McKoy JM, Trifilio SM, Holbrook J, Edwards BJ, et al. Impact of United States Food and Drug Administration's boxed warnings on adverse drug reactions reporting rates and risk mitigation for multiple myeloma drugs. Expert Opinion on Drug Safety. 2013;12(3):299–307.
- **39** Roughead EE, Gilbert AL, Primrose JG. Improving drug use: a case study of events which led to changes in use of flucloxacillin in Australia. *Social Science & Medicine*. 1999;**48**(6):845–53.
- **40** Choudhry NK, Anderson GM, Laupacis A, Ross-Degnan D, Normand SL, Soumerai SB. Impact of adverse events on prescribing warfarin in patients with atrial fibrillation: matched pair analysis. *British Medical Journal*. 2006;**332**(7534):141–5.
- **41** Flodgren G, Parmelli E, Doumit G, Gattellari M, O'Brien MA, Grimshaw J, et al. Local opinion leaders: effects on professional practice and health care outcomes. *Cochrane Database of Systematic Reviews*. 2011:**8**:CD000125.
- **42** Colquhoun HL, Brehaut JC, Sales A, Ivers N, Grimshaw J, Michie S, et al. A systematic review of the use of theory in randomized controlled trials of audit and feedback. *Implementation Science*. 2013;**8**:66.
- **43** Ivers NM, Sales A, Colquhoun H, Michie S, Foy R, Francis JJ, et al. No more 'business as usual' with audit and feedback interventions: towards an agenda for a reinvigorated intervention. *Implementation Science*. 2014;**9**:14.
- **44** Gardner B, Whittington C, McAteer J, Eccles MP, Michie S. Using theory to synthesise evidence

- from behaviour change interventions: the example of audit and feedback. *Social Science & Medicine*. 2010;**70**(10):1618–25.
- **45** Klein LA, Ritchie JE, Nathan S, Wutzke S. An explanatory model of peer education within a complex medicines information exchange setting. *Social Science & Medicine*. 2014;**111**:101–9.
- **46** Hrisos S, Eccles M, Johnston M, Francis J, Kaner EF, Steen N, et al. Developing the content of two behavioural interventions: using theory-based interventions to promote GP management of upper respiratory tract infection without prescribing antibiotics #1. *BMC Health Services Research*. 2008:**8**:11.
- **47** Roughead EE, Kalisch Ellett LM, Ramsay EN, Pratt NL, Barratt JD, LeBlanc VT, et al. Bridging evidence-practice gaps: improving use of medicines in elderly Australian veterans. *BMC Health Services Research*. 2013;**13**:514.
- **48** Wutzke SE, Artist MA, Kehoe LA, Fletcher M, Mackson JM, Weekes LM. Evaluation of a national programme to reduce inappropriate use of antibiotics for upper respiratory tract infections: effects on consumer awareness, beliefs, attitudes and behaviour in Australia. *Health Promotion International*. 2007;**22**(1):53–64.

- 1 von Staden H. Herophilus: The Art of Medicine in Early Alexandria. Cambridge, Cambridge University Press, 1989.
- **2** Sackett DL, Rosenberg WMC, Gray JAM, Haynes RB, Richardson WS. Evidence based medicine: what it is and what it isn't. *British Medical Journal*. 1996;**312**(7023):71–2.
- **3** Likic R, Maxwell SRJ. Prevention of medication errors: teaching and training. *British Journal of Clinical Pharmacology*. 2009;**67**(6):656–61.
- **4** Van Der Horst K, Giger M, Siegrist M. Attitudes toward shared decision-making and risk communication practices in residents and their teachers. *Medical Teacher.* 2011;**33**(7):e358–63.
- 5 Hammond K. Human Judgment and Social Policy: Irreducible Uncertainty, Inevitable Error, Unavoidable Injustice. New York, Oxford University Press, 1996.
- **6** McWhinney IR, Freeman T. *Textbook of Family Medicine*. Oxford, Oxford University Press, 2009.
- 7 Shojania KG, Burton EG, McDonald KM, Goldman L. Changes in rates of autopsy-detected diagnostic errors over time a systematic review. *Journal of the American Medical Association*. 2003;289(21):2849–56.
- **8** Kirch W, Schafii C. Misdiagnosis at a university hospital in 4 medical eras. *Medicine*. 1996;**75**(1):29–40.
- **9** Semark B, Engstrom S, Brudin L, Tagerud S, Fredlund K, Borgquist L, Petersson G. Factors influencing the prescription of drugs of different price levels. *Pharmacoepidemiology & Drug Safety*. 2013;**22**(3):286–93.
- **10** Peile E. Evidence-based medicine and values-based medicine: partners in clinical education as well as in clinical practice. *BMC Medicine*. 2013;**11**(1):40.
- **11** Dowie J. Researching doctors' decisions. *Quality & Safety in Health Care*. 2004;**13**(6):411−12.

- **12** Denig P, Haaijer-Ruskamp F. Do we need individualised prescribing quality assessment? The case of diabetes treatment. *International Journal of Clinical Pharmacy*. 2011;**33**(2):145–9.
- 13 National Institute for Health and Care Excellence. Key Therapeutic Topics Medicines Management Options for Local Implementation: Interim Process Statement. Available from: http://publications.nice.org.uk/key-therapeutic-topics-medicines-management-options-for-local-implementation-interim-process-pmg7 (last accessed 18 November 2015).
- 14 Kontopantelis E, Springate D, Reeves D, Ashcroft DM, Valderas JM, Doran T. Withdrawing performance indicators: retrospective analysis of general practice performance under UK Quality and Outcomes Framework. *British Medical Journal*. 2014;348:g330.
- 15 Health and Social Care Information Centre. QIPP Prescribing Comparators (2013/14): Descriptions and Specifications. Available from: http://www.hscic.gov.uk/prescribing/measures (last accessed 18 November 2015).
- **16** Wilson-Davis K, Stevenson WG. Predicting prescribing costs: a model of northern Ireland general practices. *Pharmacoepidemiology & Drug Safety*. 1992;**1**(6):341−5.
- **17** McGavock H. The prescribing jigsaw: getting prescribing costs into perspective. *Occasional Paper Series*. 1995;**69**:30–43.
- **18** Davey P, Brown E, Charani E, Fenelon L, Gould IM, Holmes A, Ramsay CR, Wiffen PJ, Wilcox M. Interventions to improve antibiotic prescribing practices for hospital inpatients. *Cochrane Database of Systematic Reviews*. 2013;**4**:210.
- **19** Dismuke CE, Egede LE. Medicare part D prescription drug program: benefits, unintended conse-

- quences and impact on health disparities. *Journal of General Internal Medicine*. 2013;**28**(7):860–1.
- **20** Wettermark B, Godman B, Jacobsson B, Haaijer-Ruskamp F. Soft regulations in pharmaceutical policy making. *Applied Health Economics and Health Policy*. 2009;**7**(3):137–47.
- **21** Godman B, Wettermark B, Van Woerkom M, Fraeyman J, Alvarez-Madrazo S, Berg C, et al. Multiple policies to enhance prescribing efficiency for established medicines in Europe with a particular focus on demand-side measures: findings and future implications. *Frontiers in Pharmacology*, 2014;**5**:106.
- **22** Paisley W, Atkin CK. Public communication campaigns. In: Rice RE, Atkin CK, eds. *Public Communication Campaigns The American Experience, 4th edn.* Thousand Oaks, CA, SAGE Publications, 2013: 21–34.
- 23 Cochrane Effective Practice and Organisation of Care. Scope of our work. Available from: http://epoc.cochrane.org/scope-our-work-0 (last accessed 18 November 2015).
- **24** Cochrane Effective Practice and Organisation of Care. EPOC taxonomy. Available from: http://epoc.cochrane.org/sites/epoc.cochrane.org/files/uploads/2015%20EPOC%20Taxonomy%20FINAL.pdf (last accessed 18 November 2015).
- **25** Rx for Change Interventions Database: http://www.cadth.ca/en/resources/rx-for-change.
- 26 O'Brien MA, Rogers S, Jamtvedt G, Oxman AD, Odgaard-Jensen J, Kristoffersen DT, et al. Educational outreach visits: effects on professional practice and health care outcomes. *Cochrane Database of Systematic Reviews*. 2007;4:CD000409.
- **27** Grimshaw JM, Eccles MP, Lavis JN, Hill SJ, Squires JE. Knowledge translation of research findings. *Implementation Science*. 2012;**7**:17.
- **28** Grimshaw J, Thomas R, Maclennan G, Fraser C, Ramsay C, Vale L, et al. Effectiveness and efficiency of guideline dissemination and implementation strategies. *Health Technology Assessment*. 2004;**8**(6):iii–72.
- 29 Medical Research Council. A Framework for Development and Evaluation of RCTs for Complex Interventions to Improve Health. Available from: http://www.mrc.ac.uk/documents/pdf/rcts-for-complex-interventions-to-improve-health/ (last accessed 18 November 2015).

- 30 Medical Research Council. Developing and Evaluating Complex Interventions. Available from: http:// www.mrc.ac.uk/documents/pdf/complex-interventions-guidance/ (last accessed 18 November 2015).
- 31 Freemantle N, Eccles M, Wood J, Mason J, Nazareth I, Duggan C, et al. A randomized trial of Evidence-based OutReach (EBOR): rationale and design. *Controlled Clinical Trials*. 1999;20(5):479–92.
- **32** Freemantle N, Nazareth I, Eccles M, Wood J, Haines A, and Evidence-Based OutReach Trialists. A randomised controlled trial of the effect of educational outreach by community pharmacists on prescribing in UK general practice. *British Journal of General Practice*. 2002;**52**(477):290–5.
- 33 Nazareth I, Freemantle N, Duggan C, Mason J, Haines A. Evaluation of a complex intervention for changing professional behaviour: the Evidence Based Out Reach (EBOR) Trial. *Journal of Health Services Research & Policy*. 2002;7(4):230–8.
- 34 Eccles M, McColl E, Steen N, Rousseau N, Grimshaw J, Parkin D, Purves I. Effect of computerised evidence based guidelines on management of asthma and angina in adults in primary care: cluster randomised controlled trial. *British Medical Journal*. 2002;325(7370):941.
- **35** Rousseau N, McColl E, Newton J, Grimshaw J, Eccles M. Practice based, longitudinal, qualitative interview study of computerised evidence based guidelines in primary care. *British Medical Journal*. 2003;**326**(7384):314.
- **36** Samore MH, Bateman K, Alder SC, Hannah E, Donnelly S, Stoddard GJ, et al. Clinical decision support and appropriateness of antimicrobial prescribing: a randomized trial. *Journal of the American Medical Association*. 2005;**294**(18):2305–14.
- **37** Gonzales R, Anderer T, McCulloch CE, Maselli JH, Bloom FJ Jr, Graf TR, et al. A cluster randomized trial of decision support strategies for reducing antibiotic use in acute bronchitis. *Journal of the American Medical Association Internal Medicine*. 2013;**173**(4):267–73.
- 38 Effective Health Care Program. Developing a Protocol for Observational Comparative Effectiveness Research: A User's Guide. Available from: http://www.effectivehealthcare.ahrq.gov/ehc/products/440/1166/User-Guide-to-Observational-CER-1-10-13.pdf (last accessed 18 November 2015).

- **39** Sox HC, Greenfield S. Comparative effectiveness research: a report from the Institute of Medicine. *Annals of Internal Medicine*. 2009;**151**(3):203–5.
- **40** Rossi P. The iron law of evaluation and other metallic rules. *Research in Social Problems and Public Policy*. 1987;**4**(1987):3–20.
- **41** Pawson R, Tilley N. *Realistic Evaluation*. London, SAGE Publications, 1997.
- **42** Pawson R, Greenhalgh T, Harvey G, Walshe K. Realist review a new method of systematic review designed for complex policy interventions. *Journal of Health Services Research & Policy.* 2005;**10**(Suppl. 1):21–34.
- **43** Berwick DM. The science of improvement. *Journal of the American Medical Association*. 2008;**299**(10): 1182–4.
- **44** Bonell C, Fletcher A, Morton M, Lorenc T, Moore L. Realist randomised controlled trials: a new approach to evaluating complex public health interventions. *Social Science & Medicine*. 2012;**75**(12):2299–306.
- **45** Marchal B, Westhorp G, Wong G, Van Belle S, Greenhalgh T, Kegels G, Pawson R. Realist RCTs of complex interventions an oxymoron. *Social Science & Medicine*. 2013:**94**:124–8.
- **46** Bonell C, Fletcher A, Morton M, Lorenc T, Moore L. Methods don't make assumptions, researchers do: a response to Marchal et al. *Social Science & Medicine*. 2013;**94**:81–2.

- **47** Wong G, Greenhalgh T, Westhorp G, Buckingham J, Pawson R. RAMESES publication standards: realist syntheses. *BMC Medicine*. 2013;**11**:21.
- **48** Wong G, Greenhalgh T, Westhorp G, Buckingham J, Pawson R. RAMESES publication standards: meta-narrative reviews. *BMC Medicine*. 2013;**11**:20.
- **49** Solomon J, Knapp P, Raynor DK, Atkin K. Worlds apart? An exploration of prescribing and medicine-taking decisions by patients, GPs and local policy makers. *Health Policy*. 2013;**112**(3):264–72.
- **50** Greenhalgh T, Heath I. Measuring quality in the therapeutic relationship part 1: objective approaches. *Quality and Safety in Health Care*. 2010;**19**(6):475–8.
- **51** Greenhalgh T, Heath I. Measuring quality in the therapeutic relationship part 2: subjective approaches. *Quality and Safety in Health Care*. 2010;**19**(6):479–83.
- **52** Denig P, Haaijer-Ruskamp FM. Therapeutic decision making of physicians. *Pharmaceutisch Weekblad. Scientific Edition*. 1992;**14**(1):9–15.
- 53 Denig P, Haaijer-Ruskamp FM, Wesseling H, Versluis A. Towards understanding treatment preferences of hospital physicians. Social Science & Medicine. 1993;36(7):915–24.
- **54** Dreyer NA. Using observational studies for comparative effectiveness: finding quality with GRACE. *Journal of Comparative Effectiveness Research*. 2013;**2**(5):413–18.