

for patients with COPD exacerbations, but most patients with acute chest infections (in whom pneumonia is not suspected and without significant past medical histories) should not receive antibiotics.

Further research is needed to see if there are other 'special' patient subgroups more likely to benefit from antibiotics (for example, those with haemoptysis and infective exacerbation of asthma), and to evaluate if other remedies can safely and effectively replace antibiotics. But given the strength of evidence to date, perhaps we should also ask ourselves if 88% of patients with acute LRTI can all be special?

Alastair D Hay,

Professor of Primary Care and NIHR Research Professor, Centre for Academic Primary Care, School of Social and Community Medicine, University of Bristol, Bristol.

REFERENCES

1. McCormick A, Fleming D, Charlton J. *Morbidity statistics from general practice. Fourth National study 1991-1992*. London: HMSO, 1995.
2. Macfarlane JT, Holmes WF, Macfarlane RM. Reducing reconsultations for acute lower respiratory tract illness with an information leaflet: a randomized controlled study of patients in primary care. *Br J Gen Pract* 1997; **47(424)**: 719-722.
3. Ashworth M, Charlton J, Ballard K, et al. Variations in antibiotic prescribing and consultation rates for acute respiratory infection in UK practices 1995-2000. *Br J Gen Pract* 2005; **55**: 603-608.
4. Little P, Rumsby K, Kelly J, et al. Information leaflet and antibiotic prescribing strategies for acute lower respiratory tract infection: a randomized controlled trial. *JAMA* 2005; **293(24)**: 3029-3035.
5. Smucny J, Fahey T, Becker L, Glazier R. Antibiotics for acute bronchitis. *Cochrane Database Syst Rev* 2004; **4**: CD000245.
6. Costelloe C, Metcalfe C, Lovering A, et al. Effect of antibiotic prescribing in primary care on antimicrobial resistance in individual patients: systematic review and meta-analysis. *BMJ* 2010; **340**: c2096.
7. Hay AD, Costelloe C. Antibiotics for childhood urinary tract infection: can we be smarter? *Br J Gen Pract* 2013; **63(609)**: 175-176.
8. Royal College of General Practitioners. Research & Surveillance Centre Weekly Returns Service Annual Report 2011. <http://www.rcgp.org.uk/clinical-and-research/-/media/Files/CIRC/Research%20and%20Surveillance%20Centre/RSC%20Annual%20Report%20-%202011/Annual%20Report%202011%20Final%20%282%29/RSC%20Annual%20Report%202011.ashx> [accessed 13 Jan 2014].
9. Kumar S, Little P, Britten N. Why do general practitioners prescribe antibiotics for sore throat? Grounded theory interview study. *BMJ* 2003; **326**: 138.

ADDRESS FOR CORRESPONDENCE

Alastair D Hay

Centre for Academic Primary Care, School of Social and Community Medicine, University of Bristol, Canynge Hall, 39 Whatley Road, Clifton, Bristol, BS8 2PS, UK.

E-mail: alastair.hay@bristol.ac.uk

Kate Tilling,

Professor of Medical Statistics, School of Social and Community Medicine, University of Bristol, Bristol.

Provenance

Commissioned; not externally peer reviewed.

Competing interests

The authors have declared no competing interests.

DOI: 10.3399/bjgp14X676636

10. Davies SC. *Annual Report of the Chief Medical Officer 2011: volume 2*. London: Department of Health, 2013.
11. Department of Health. *UK Five Year Antimicrobial Resistance Strategy 2013 to 2018*. London: Department of Health, 2013.
12. Moore M, Stuart B, Coenen S, et al. Amoxicillin for acute lower respiratory tract infection in primary care: subgroup analysis of potential high-risk groups. *Br J Gen Pract* 2014; DOI: 10.3399/bjgp14X677121.
13. Hamoen M, Broekhuizen BDL, Little P, et al. Medication use in European primary care patients with lower respiratory tract infection: an observational study. *Br J Gen Pract* 2014; DOI: 10.3399/bjgp14X677130.
14. Little P, Stuart B, Moore M, et al. Amoxicillin for acute lower-respiratory-tract infection in primary care when pneumonia is not suspected: a 12-country, randomised, placebo-controlled trial. *Lancet Infect Dis* 2013; **13(12)**: 123-129.
15. Watson L, Little P, Moore M, et al. Validation study of a diary for use in acute lower respiratory tract infection. *Fam Pract* 2001; **18(5)**: 553-554.
16. Brookes ST, Whitely E, Egger M, et al. Subgroup analyses in randomized trials: risks of subgroup-specific analyses; power and sample size for the interaction test. *J Clin Epidemiol* 2004; **57(3)**: 229-236.
17. Rothwell PM. Treating individuals 2. Subgroup analysis in randomised controlled trials: importance, indications, and interpretation. *Lancet* 2005; **365(9454)**: 176-186.
18. Wang R, Lagakos SW, Ware JH, et al. Statistics in medicine-reporting of subgroup analyses in clinical trials. *N Engl J Med* 2007; **357(21)**: 2189-2194.
19. Goossens H, Ferech M, Vander Stichele R, et al. Outpatient antibiotic use in Europe and association with resistance: a cross-national database study. *Lancet* 2005; **365(9459)**: 579-587.

There is no shortage of international policy documents outlining the importance of primary care. But does the reality match up to the rhetoric? This is answered in part in a study by Kringos *et al.*¹ They describe primary care in 31 European countries in terms of investment in primary care, governance, workforce development, access, services delivered, continuity, coordination, comprehensiveness, and GPs' income.

One fundamental, if not surprising observation is that primary care is highly variable. This starts from defining who provides primary care, to whether 'GP' means the same thing in different countries, whether GPs work single-handedly or collaborate with others in multidisciplinary teams, whether they have a gatekeeping role, whether they have a registered list and the range of services that are provided, to working conditions and income. Using a wide range of indicators on the different dimensions, Kringos and colleagues developed a measure of 'strength of primary care', according to which countries such as the UK, Denmark, and Netherlands rank top, while others such as Austria, Cyprus, Greece, Hungary, and Ireland score poorly on care structures considered key for strong primary care. The study provides a great deal of detail to add to previous surveys documenting wide variation between primary care in different countries.²

CHALLENGES FOR PRIMARY CARE

In a separate article, the same authors looked at the relationship between strength of primary care countries and the outcomes and the cost of health care provided.³ They found that countries with strong primary care systems had better health outcomes but, contrary to received wisdom,^{4,5} these countries had more expensive healthcare systems relative to national income. However the article suggests no room for complacency in terms of thinking that primary care is necessarily cheaper than specialist care. Nor can we be complacent about primary care producing better health outcomes: Vedsted and Olesen⁶ found that countries in which GPs were gatekeepers to specialist care had lower survival for cancer, which suggested that gatekeeping might have 'unexpected serious side effects'. Countries such as France, which

"There is increasing recognition that primary care should be organised to take responsibility for whole populations of patients."

are rated medium in terms of primary care, are among the top performers in relation to health outcomes that can be attributed to health care.⁷

So where are we then? There is widespread variation in the way primary care is conceptualised and implemented, and some uncertainties about the costs and effectiveness of primary care. What is clear is that the changing burden of disease vis-à-vis ageing populations requires a different approach to service delivery and components such as continuity and care coordination that are core dimensions of primary care, which have been shown to be effective (to a degree) to meet the needs of those with complex conditions.^{8,9} How should we then expect primary care to develop in the future? We address this from two perspectives: how should primary care be organised? And how should it be financed?

FUTURE ORGANISATION OF PRIMARY CARE

There is increasing recognition that primary care should be organised to take responsibility for whole populations of patients. In countries with registered populations GPs take responsibility for screening programmes and increasingly for a wide range of chronic disease management programmes. However, one of the key objectives in extending GPs' population responsibilities in future is to improve the integration of care which is a major priority with our increasingly aged and multimorbid patients. To do this general practice needs to change. GPs increasingly need access to the skills of a multidisciplinary team and to facilities for investigation and treatment. This is at odds

with the organisation of general practice in many countries where GPs are self-employed, often working single-handed or in small groups. Recent work describes a number of models which are emerging in the UK and other countries that seek to provide the benefits of organisational scale while preserving the local nature of general practice,^{10,11} suggesting design principles for clinical care and organisation of general practice that will be needed to meet the needs of patients in future.¹⁰

FUTURE FUNDING OF PRIMARY CARE

We also need new models of funding primary care to enable provision of better integrated care. Increasingly, there are moves to try to promote integration of care through so called 'bundled payment systems' which may include payments being made to more than one provider (that is, primary and secondary care) to cover whole episodes of illness, or for implementing care pathways or disease management programmes. Such schemes are now evident in the Netherlands.¹² These schemes recognise that payment systems which encourage multiple providers and give them different incentives are unlikely to provide well coordinated care. Pay-for-performance is also increasingly used in primary care and has spread from the UK to Germany, France, Estonia, Hungary, and Sweden despite limited evidence of its benefits unless used as part of other quality improvement initiatives.¹³ Pay-for-performance schemes also have a problem that they tend to prioritise the management of single conditions over integrated care.

A major recent innovation in funding is the potential for primary care to use its population responsibility to take on wider

"... new models of funding primary care to enable provision of better integrated care."

financial responsibility for patients. The first example is in the UK where groups of GPs (clinical commissioning groups) now have budgetary responsibility for the majority of the healthcare budget to their patients including hospital and specialist care. The second example is in the US where the concept of 'accountable care organisations' gives budgetary responsibility for defined populations to providers of health care, although in the US this is more likely to be a combination of generalists and specialists rather than primary care physicians having lead responsibility.

An anomaly of the UK's current healthcare reform is that the CCGs are responsible for purchasing specialist care but do not have responsibility for primary care. It seems clear that they cannot manage a population budget without taking an interest in both, and early indications are that they are doing exactly that with, for example, contracts that involve specialist, primary, and community care.¹⁴ Currently neither hospital nor general practice payment systems in the UK encourage integrated care, and both need to change to do so.

THE NEED FOR REFORM

Primary care in many countries is unrecognisable from 20 years ago. Countries are bound to continue to reform their healthcare systems to deal with the new challenges of ageing populations, and therefore changes to both the organisation and financing of primary care are inevitable. GPs have proved to be both adaptable and entrepreneurial over many years. They will need to show continued ability to adapt to a changing environment.

Martin Roland,
RAND Professor of Health Services Research,
Institute of Public Health, University of Cambridge
School of Clinical Medicine, Cambridge.

Ellen Nolte,
Director, Health and Healthcare, RAND Europe,
Cambridge.

Provenance
Commissioned; not externally peer reviewed.

Competing interests
The authors have declared no competing interests.

DOI: 10.3399/bjgp14X676960

ADDRESS FOR CORRESPONDENCE

Martin Roland
Institute of Public Health, Forvie Site, University of
Cambridge School of Clinical Medicine, Box 113
Cambridge Biomedical Campus, Cambridge,
CB2 0SR, UK

E-mail: mr108@cam.ac.uk

REFERENCES

1. Kringos D, Boerma W, Bourqueil Y, *et al*. The strength of primary care in Europe: an international comparative study. *Br J Gen Pract* 2013; DOI: 10.3399/bjgp13X674422.
2. Schoen C, Osborn R, Squires D, *et al*. A survey of primary care doctors in ten countries shows progress in use of health information technology, less in other areas. *Health Affairs* 2012; **31(12)**: 2805–2816.
3. Kringos D, Boerma W, van der Zee J, Groenewegen P. Europe's strong primary care systems are linked to better population health but also to higher health spending. *Health Affairs* 2013; **32(4)**: 686–694.
4. Starfield B, Shi L, Macinko J. Contribution of primary care to health systems and health. *Milbank Q* 2005; **83(3)**: 457–502.
5. Friedberg MW, Hussey P, Schneider E. Primary care: a critical review of the evidence on quality and costs of health care. *Health Affairs* 2010; **29(5)**: 766–772.
6. Vedsted P, Olesen F. Are the serious problems in cancer survival partly rooted in gatekeeper principles? An ecologic study. *Br J Gen Pract* 2011; DOI: 10.3399/bjgp11X588484.
7. Nolte E, McKee M. Variations in amenable mortality — trends in 16 high-income nations. *Health Policy* 2011; **103**: 47–52.
8. Powell Davies PG, Williams AW, Larsen K, *et al*. Coordinating primary health care: an analysis of the outcomes of a systematic review. *Med J Aust* 2008; **188(8 Suppl)**: S65–S68.
9. Coleman K, Mattke S, Perrault P, Wagner E. Untangling practice redesign from disease management: how do we best care for the chronically ill. *Ann Rev Public Health* 2009; **30**: 385–408.
10. Smith J, Holder H, Edwards N, *et al*. *Securing the future of general practice: new models of primary care*. www.nuffieldtrust.org.uk/sites/files/nuffield/130718_securing_the_future_of_general_practice_-_full_report_0.pdf [accessed 13 Jan 2014].
11. Casalino L, Wu F, Ryan A, *et al*. Independent practice associations and physician-hospital organisations can improve care management for smaller practices. *Health Affairs* 2013; **32**: 1367–1382.
12. Charlesworth A, Davies A, Dixon J. *Reforming payment for health care in Europe to achieve better value*. www.nuffieldtrust.org.uk/publications/reforming-payment-health-care [accessed 13 Jan 2014].
13. Roland M. Pay for performance: not a magic bullet [editorial]. *Ann Intern Med* 2012; **157**: 912–913.
14. Naylor C, Curry N, Holder H, *et al*. *Clinical commissioning groups: supporting improvement in general practice*. www.nuffieldtrust.org.uk/publications/clinical-commissioning-groups-supporting-improvement-general-practice [accessed 13 Jan 2014].

Editorials

Ecological studies:

use with caution

BACKGROUND

Ongoing debates about the quality of NHS organisations have made ecological studies fashionable. One such study in the UK considered the association between the average clinical quality of primary care provided by primary care trusts and the trusts' rate of admission for coronary heart disease.¹ An alternative to this ecological approach, which used data aggregated to the level of a primary care trust, would have been to have used data for individual patients, and to have asked if there was an association between the clinical quality of care an individual receives and their own chance of being hospitalised for coronary heart disease. By using aggregated data in ecological studies the relationship for individual patients is not directly explored, although individual relationships may often (correctly or incorrectly) be inferred from population-based analyses. Ecological studies can either be descriptive, for example, exploring variation between populations, or consider associations such as the example above. In health services research, where healthcare organisations rather than individual patients are often the focus of inquiry, ecological studies are often an appealing tool. For example, a recent study looking at the features of general practices associated with lower coronary heart disease mortality was more concerned with the practice at an organisational level than with individuals.²

STRENGTHS OF THIS APPROACH: OPEN DATA AND ORGANISATION ANALYSES

The availability of data describing NHS organisations has never been greater. A large volume of UK healthcare process and outcome data is becoming publicly available from the Health and Social Care Information Centre (<http://www.hscic.gov.uk/>) and via the government open data website (<http://www.data.gov.uk/>) with GP practice, hospital, and clinical commissioning group (CCG) indicators available. Indicators cover measures including population, service, clinical outcome, prescribing and patient experience. The UK Data Archive (<http://data-archive.ac.uk/>) is another source of publicly available data, including individual level data from health surveys. With the UK white paper from 2012 presenting the government strategy to make more data

“Ecological studies in health services research are a powerful tool and with the wealth of organisational level data now available there are increasing numbers of research questions where they are the study design of choice.”

public³ the amount of data available is only going to increase.

One strong advantage of using publicly available data in research is that there are no problems with data confidentiality. When looking at associations between risk factors and outcomes, linking information about individual patients often requires extensive ethical and governance approval. Linking data at the organisational level, however, does not, as usually the data have been published and are in the public domain already. Ecological studies also allow us to look nationwide providing evidence that is potentially more generalisable than from studies considering individuals, but in only a small geographical area. A further strength of ecological studies is that where data are available the exploration of potential trends over time can be considered with relative ease.

The strength of an ecological study for looking at associations at the institutional level (hospital, CCG or GP practice) is balanced by the fact that we cannot draw conclusions about individual patients from population data. We can tell whether GP practices where patients report a better experience of care are those that achieve higher QOF targets,⁴ but this tells us nothing about the association between patient experience and the quality of clinical care at the patient level. Ecological studies are at best hypothesis generating when considering individual level associations and care is needed to avoid the risk of ecological fallacy: assuming the associations that exist at the population level persist at the individual level. Ecological analyses which consider within-institution trends-over-time are less vulnerable to these problems, but not immune.

CAUTIONS: CONFOUNDING, BIAS, AND ECOLOGICAL FALLACY

Considerations applicable to any type of

epidemiological research also apply to ecological studies, for example in relation to potential confounding (where two domains of care appear associated, but this is in fact simply because they are both associated with a third, confounding, variable). Where there is confounding by individual level variables (such as clinical diagnosis or disease severity case mix or sociodemographic variation), then if individual level data are available for one of the measures of interest, accounting for potential confounding at the ecological level is possible.⁵ Information may also be available at the organisational level about possible confounders, but individual level data are needed if individual level confounders are the concern.

The importance of these last two points (potential for ecological fallacy and unmeasured confounding), when interpreting correlations observed at the organisational level, cannot be overstated. A simple, unadjusted, correlation of two measures at the population level has the potential for eye-catching headlines, such as the study of the association between chocolate consumption and winning a Nobel prize.⁶ However, the potential for ecological studies to lead into suboptimal policy-making is high; confounding and ecological fallacy mean that an unthinking analysis of associations at the organisational rather than the individual level may have far reaching consequences. Recently it has been claimed that NHS hospitals that operate in a more competitive geographical environment have a lower mortality rate for patients with myocardial infarction.⁷ Whether this association was causal or not has been a subject of a lively debate.⁸

Data completeness is also important. Complete and accurate data is incentivised in the NHS, but there remains variation in quality and validity across organisations. For example, exception reporting varies