Are rates of pathology test ordering higher in general practices co-located with pathology collection centres?

David M Studdert, Helena C Britt, Ying Pan, Salma Fahridin, Clare F Bayram and Lyle C Gurrin

ABSTRACT

Objective: To determine whether rates of pathology test ordering by general practitioners in general practices co-located with pathology collection centres (PCCs) are higher than those of GPs in practices located apart from PCCs.

Design, setting and participants: We identified all practices in the Melbourne and Sydney metropolitan areas that were co-located with PCCs (same or immediately adjacent suite) and the date co-location was established. This information was merged with the Bettering the Evaluation and Care of Health database to identify samples of GP–patient encounters in co-located practices ($n = 31\,700$) and practices located apart from the nearest PCC ($n = 289\,700$) over the period 2000–2009. Using Poisson regression analysis and logistic regression analysis, we compared GP test-ordering rates across the two types of practices, controlling for a range of potential confounders.

Main outcome measures: Numbers of tests ordered per encounter; likelihood of ordering one or more tests per encounter.

Results: In unadjusted analyses, GPs in co-located practices ordered more pathology tests than GPs in practices located apart from PCCs (40.3 v 37.0 tests per 100 encounters, $P = 0.01$) and had a higher likelihood of ordering one or more tests (16.8% v 15.5% of encounters, $P < 0.01$). After adjusting for other predictors of test ordering, however, neither test-ordering rate (rate ratio, 0.98; 95% CI, 0.93–1.05; $P = 0.56$) nor likelihood of ordering one or more tests per encounter (odds ratio, 1.01; 95% CI, 0.95–1.07; $P = 0.79$) differed significantly by co-location status. Sub-analyses within specific test groups and types showed few systematic differences.

Conclusions: Pathology test-ordering rates are not higher in practices co-located with PCCs. To the extent inappropriate commercial influences and relationships exist in the pathology sector, GPs' test-ordering behaviour may be unaffected.

MJA 2010; 193: 114–119

Pathology services currently account for 14%, or $2 billion per annum, of Medicare expenditure.[1] Over the past decade, pathology service costs have increased rapidly in Australia and many other developed countries.[2] Nearly 70% of public expenditure on pathology services in Australia goes towards tests ordered by general practitioners.[3]

Outside hospitals, pathology service delivery in Australia is dominated by a few large companies; it is an oligopoly. Specimens are collected from patients at general practices or pathology collection centres (PCCs) and couriered to central laboratories for testing. More than 80% of PCCs are owned and operated by one of the country's four major pathology companies.[4] Pathology companies compete to place PCCs in the most commercially advantageous locations. Commonly, that will be in or adjacent to busy general practices. The pathology companies then strive to secure and maintain the referral allegiance of their GP neighbours.

Regulators have long worried about these arrangements.[5-8] The nub of the policy concern is that the structure of pathology markets, coupled with the close professional relationships that exist between doctors and pathology company staff, may stimulate over-testing.[7] In 2007, the federal government introduced new rules aimed at curbing inappropriate influences in the delivery of pathology and imaging services,[9] including sham commercial relationships, such as landlord–tenant deals, used to mask "kickbacks" to doctors for referrals. Recent media reports suggest a forthcoming federal government taskforce to investigate claims of bribery and kickbacks in the pathology industry,[10] and at least one such allegation is currently being litigated.[11]

If the pathology industry exerts influence, directly or indirectly, over GPs' test-ordering practices, that influence would logically be stronger in environments where the two are in regular and close working contact. We compared rates of pathology test ordering by GPs in general practices co-located with PCCs with those of GPs in practices located apart from PCCs. Our hypothesis was that test-ordering rates would be higher among GPs in co-located practices.

METHODS

Data collection

Data on pathology test ordering by GPs were obtained from the Bettering the Evaluation and Care of Health (BEACH) program. BEACH is a continuous national cross-sectional study of GP activity, involving ever-changing random samples of about 1000 GPs per year. Each GP participant completes a questionnaire about themselves and their practice, and uses a structured encounter form to record details of 100 consecutive patient encounters. This produces information on about 100 000 GP–patient encounters each year. Ethics committees of the University of Sydney and the Australian Institute of Health and Welfare approved the BEACH study.

Details that participating GPs record on each encounter cover up to four specific problems managed, and how they were managed — including up to five pathology tests or batteries of tests ordered. The BEACH program classifies problems managed and pathology tests ordered[12] according to the International Classification of Primary Care (ICPC-2);[13] the problems and tests are also coded more specifically at the GP terminology level using ICPC-2 PLUS.[14] In addition, pathology tests are mapped to the main pathology service groups in the Medicare Benefits Schedule (MBS). For this analysis, problems managed were analysed at the ICPC-2 chapter level.[13] We sub-analysed pathology test data at two levels: by the eight MBS pathology service groups and, more specifically, by 19 pathology tests commonly ordered by GPs[12] (Box 1).

Definition and identification of co-located practices

We defined a practice as co-located with a PCC if it occupied the same premises as a PCC, either in a shared suite or in an immediately adjacent suite. As the BEACH

program does not collect information about the proximity of practices to PCCs, this was determined by other means. From a publicly available list of all Department of Health and Ageing-approved PCCs and their locations,[15] we identified all PCCs located within the metropolitan boundaries[16] of Melbourne and Sydney. Between December 2008 and February 2009, we telephoned each of these PCCs and asked for the name and location of the nearest general practice. Hospital-based PCCs were dropped from further consideration. For PCCs associated with specialty medical practices, the standard query about location of the nearest general practice applied. The geographical distance between each PCC and its nearest general practice was then verified via online searches of addresses and by using Google Maps (http://maps.google.com.au/). Next, for all PCCs that shared a suite with or occupied a suite adjacent to a general practice, we obtained the year in which the co-location was established via a telephone call to the PCC staff and/or the general practice manager.

Data matching and construction of study sample

We compared the addresses of the co-located practices with the practice addresses of BEACH participants from survey years 2000–01 to 2008–09 inclusive. Participants whose addresses matched those of co-located practices were included in the study sample as co-located practice GPs, provided that the year of survey participation post-dated the year co-location was established. We also compared the addresses of near-located practices (within 50 metres of a PCC but not in the same or immediately adjacent suite) to the practice addresses of BEACH participants and excluded any such matches ($n = 144$) from the analysis. All remaining unmatched BEACH participants from metropolitan Melbourne and Sydney were considered to be working at practices located apart from PCCs.

Statistical analyses

Analyses were conducted at the GP–patient encounter level. The main outcome variables were test-ordering rates (number of pathology tests ordered per encounter, ranging from 0 to 5) and the likelihood of test ordering (a binary variable with a value of 0 if no test was ordered in an encounter and 1 if one or more tests were ordered in an encounter). The independent variable of interest was co-location, a binary variable that distinguished encounters in co-located practices from encounters in practices located apart from PCCs. The relationship between the independent variable and the outcome variables was estimated using Poisson regression analysis (test-ordering rates) and logistic regression analysis (likelihood of test ordering).

In unadjusted analyses, we regressed both outcome measures on the co-location variable and a range of practice, GP, patient and encounter characteristics. To probe the co-location predictor further, we repeated these regressions within each MBS group and test type. Adjusted analyses re-estimated the relationship between each of the outcome variables and co-location in regression models that controlled for all other covariates found to have a significant association with the outcome variables in unadjusted analyses.

Standard error calculations incorporated the single-stage clustered study design according to Kish's formula.[17] We used the statistical software package SAS 9.1.3 (SAS Institute, Cary, NC, USA) for descriptive analyses and Stata 11.0 (STATA Corp, College Station, Tex, USA) for univariate and multivariate analyses.

RESULTS

There were 367 PCCs in Melbourne and 340 PCCs in Sydney, 251 of which were co-located with general practices (126 in Melbourne, 125 in Sydney). The data-matching process identified 317 GPs from co-located practices (31 700 encounters) and 2897 GPs from practices located apart from PCCs (289 700 encounters) from among BEACH participants.

Sample characteristics

Of the 321 400 total GP–patient encounters, 10% occurred in co-located practices, 59% were in Sydney, 35% were with female GPs, 39% were with GPs 55 years or older, and 36% were with GPs who were Fellows of the Royal Australian College of General Practitioners (Box 2).

Nine per cent of encounters were with new patients. New problems were managed at a rate of 56 per 100 encounters and chronic problems at a rate of 50 per 100 encounters. By ICPC-2 chapter level, the leading problems managed were respiratory (21 per 100 encounters), circulatory (18 per 100 encounters) and musculoskeletal (17 per 100 encounters).

1 Pathology service groups and test types used for sub-analyses of pathology test data

Pathology service groups in the Medicare Benefits Schedule

- haematology
- chemistry
- microbiology
- immunology
- tissue pathology
- cytology
- infertility and pregnancy tests
- simple basic tests

Pathology tests commonly ordered by general practitioners

- full blood count
- lipids
- electrolytes, urea and creatinine
- liver function
- glucose and glucose tolerance
- Pap smear
- thyroid function
- urine microscopy, culture and sensitivity
- ferritin
- other chemistry
- erythrocyte sedimentation rate
- coagulation
- hormone assay
- other microbiology
- glycated haemoglobin
- hepatitis serology
- multibiochemical analysis
- prostate specific antigen
- vaginal swab microscopy, culture and sensitivity ◆

Unadjusted analyses

Co-location with PCC

GP in co-located practices had higher rates of pathology test ordering than GPs in practices located apart from PCCs (40.3 v 37.0 tests per 100 encounters; $P = 0.01$) (Box 3). The difference stemmed from a higher probability of ordering one or more tests at encounters in co-located practices (16.8% v 15.5% of encounters; $P < 0.01$), not from larger numbers of tests when one or more tests were ordered in an encounter (mean of 2.4 tests in both groups; $P = 0.35$).

Other variables

All of the other variables shown in Box 2 were either significantly associated ($P < 0.05$), or had one or more categories that were significantly associated, with both test-ordering rates and the likelihood of ordering one or more tests in encoun-

2 Characteristics of study sample (3214 GPs and 321 400 GP–patient encounters)*

General practices	
Co-located with pathology collection centre	10%
Location	
Sydney	59%
Melbourne	41%
Size	
Solo	13%
2–4 GPs	30%
5–9 GPs	48%
10–14 GPs	6%
15 + GPs	3%
Accredited	68%
GPs	
Female	35%
Age	
< 35 years	6%
35–44 years	20%
45–54 years	35%
55 + years	39%
Sessions per week	
< 6	17%
6–10	67%
11 +	16%
Country of graduation	
Australia	71%
United Kingdom, Ireland, New Zealand	6%
Other	23%
Fellow of the RACGP	36%
Patients	
Female	59%
Age†	
< 25 years	22%
25–44 years	26%
45–64 years	27%
65 + years	26%
New patient to practice	9%
Health Care Card holder	36%
Repatriation Health Card holder	3%

GP–patient encounters	
Medicare item level‡	
Level A	1%
Level B	74%
Level C	11%
Level D	1%
New problems§	56
Chronic problems§	50
Type of problem§¶	
Respiratory	21
Circulatory	18
Musculoskeletal	17
General and unspecified	16
Skin	16
Psychological	11
Endocrine, metabolic, nutritional	12
Digestive	10
Female genital	7
Ear	4
Neurological	4
Pregnancy, family planning	4
Eye	3
Urological	3
Blood, blood forming	2
Male genital	2
Social	1

GP = general practitioner. RACGP = Royal Australian College of General Practitioners. MBS = Medicare Benefits Schedule. * Data are percentage unless otherwise indicated. † Total of percentages is greater than 100% due to rounding. ‡ Total of percentages is less than 100% due to MBS items not covered by levels and non-MBS funded encounters. § Rate per 100 encounters. ¶ Analysed by International Classification of Primary Care (ICPC-2) chapter level.[13] ◆

ters. Hence, all were included as covariates in the adjusted analyses. In addition, test-ordering rates increased sharply over the study period in both co-located practices and practices located apart from PCCs (Box 4), so dummy variables for each BEACH survey year were included in the adjusted analyses.

Adjusted analyses

Test-ordering rates

The significant association observed in unadjusted analyses between co-location and number of pathology tests ordered per encounter did not hold in an adjusted analysis (rate ratio [RR], 0.98; 95% CI, 0.93–1.05) (Box 5). However, several other GP and practice variables were significantly associated with test-ordering rates, after adjusting for patient characteristics, encounter characteristics and survey year. Test-ordering rates were higher in accredited practices (RR, 1.12; 95% CI, 1.07–1.18), practices with 5–9 and 10–14 GPs, among female GPs (RR, 1.12; 95% CI, 1.08–1.17) and among GPs who worked 11 or more sessions per week (RR, 1.09; 95% CI, 1.01–1.17). On the other hand, test-ordering rates were lower in Sydney than Melbourne (RR, 0.90; 95% CI, 0.86–0.94) and among GPs in age groups above 44 years relative to GPs younger than 35 years.

Likelihood of test ordering

The association between co-location and the likelihood of ordering one or more tests in encounters was not significant in an adjusted analysis (odds ratio [OR], 1.01; 95% CI, 0.95–1.07; $P = 0.79$). The significance and effect sizes of the GP and practice variables in this model were virtually identical to those in the test rates model (data not shown).

MBS groups and test types

When the adjusted analyses described above were re-run within each of the eight MBS pathology service groups and 19 test types, there was no significant association between co-location and number of tests ordered per encounter in any of the MBS groups. However, the association was significant for several test types: rates of test ordering were lower among encounters in co-located practices for lipid tests (RR, 0.89; 95% CI, 0.81–0.98), electrolytes, urea and creatinine tests (RR, 0.88; 95% CI, 0.79–0.98), and glucose and glucose tolerance tests (RR, 0.86; 95% CI, 0.77–0.96).

Adjusted analyses estimating the likelihood of ordering one or more tests in encounters by MBS group and test type showed the same significant associations and very similar odds ratios, with one addition: there was a higher likelihood of ordering a urine microscopy, culture and sensitivity test in encounters at co-located practices (OR, 1.15; 95% CI, 1.01–1.31).

DISCUSSION

We found that, although several practice characteristics (location, size, accreditation) and practitioner characteristics (sex, age, sessions per week) were associated with variation in GPs' pathology test-ordering rates, the existence of a PCC within or beside a general practice was not. Thus, our

3 Pathology test-ordering frequency during GP–patient encounters at general practices co-located with PCCs ($n = 31\,700$) and general practices located apart from PCCs ($n = 289\,700$), Melbourne and Sydney, 2000–2009

	Practices co-located with PCCs (95% CI)	Practices located apart from PCCs (95% CI)	Practices co-located with PCCs v practices located apart from PCCs
Number of tests ordered per 100 encounters	40.3 (37.7–42.9)	37.0 (36.0–38.0)	Rate ratio (95% CI), 1.09 (1.02–1.17)
Percentage of encounters with one or more tests ordered	16.8 (15.9–17.7)	15.5 (15.2–15.9)	Odds ratio (95% CI), 1.10 (1.02–1.18)
Mean number of tests ordered per encounter with one or more tests ordered	2.4 (2.3–2.5)	2.4 (2.3–2.4)	Difference in means (95% CI), 0.02 (–0.06 to 0.10)

GP = general practitioner. PCC = pathology collection centre. ◆

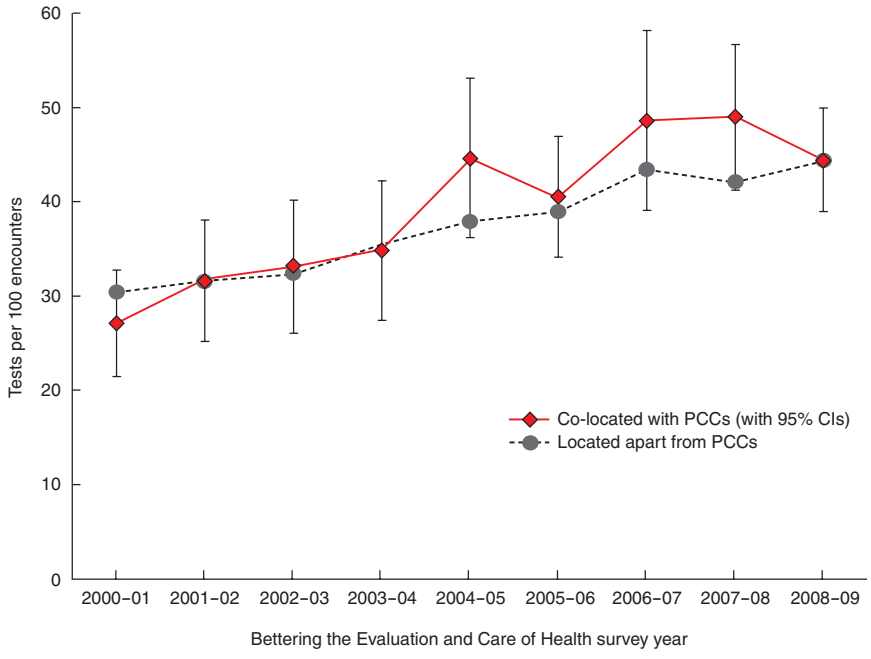
hypothesis proved incorrect. Regulators who are concerned that undue influences and conflicts of interest in the pathology sector may be skewing GPs' test-ordering behaviour should draw some comfort from this result.

To our knowledge, this is the first published study of whether doctors who have high levels of daily exposure to private pathology businesses are heavier users of the laboratory services of those businesses. The question has particular salience in the Australian health care system, where the pathology sector is much more heavily for-profit and more tightly integrated into primary care than in countries such as the United Kingdom and Canada.

An analogous body of research is relevant. Many studies have shown that doctors' contact with the pharmaceutical industry can influence their clinical decision making.[18] Repeated visits by sales representatives,[19-22] the availability of free drug samples,[23,24] and relationships forged through conferences, educational events and consultancy arrangements[25,26] have been linked to prescribing patterns. The hypothesised mechanism of action is, of course, the same as the pharmaceutical industry's rationale for spending vast sums[27] on marketing campaigns directed at doctors — namely, doctors who are regularly exposed to information, people, money and events associated with a particular product are more likely to incorporate that product into their clinical activities.

Our analysis found no evidence of such effects arising out of the close relationships between GPs and pathology companies in Australia. One possible explanation for this result is that, in Australia, pathology markets differ from pharmaceutical markets in important respects. Pathology companies sell a defined set of services; those services are relatively homogeneous from company to company; and prices are basically fixed and mostly paid by government (although this may be changing[28]). This combination of economic factors may make doctors' demand for pathology services fairly inelastic; it may also force pathology companies to compete on the basis of socially desirable attributes such as test quality, reliability, speed and convenience. In sum, the nature of pathology markets, however aggressive, may not carry the same risks of supplier-induced demand that exist in markets for other health care products, such as pharmaceuticals.

4 Pathology tests ordered per 100 GP–patient encounters, by survey year and co-location status of general practices*



GP = general practitioner. PCC = pathology collection centre. *95% confidence intervals are shown for the test-ordering rates in co-located practices only for clarity and because the absence of statistically significant differences between the two types of practices in any year is evident from a single set of confidence intervals. ◆

The GP and practice characteristics found to be associated with test-ordering rates in this study largely echo those detected in earlier Australian research. A 1994 study of Medicare data found that rates of test ordering were higher among female GPs and varied according to year of graduation from medical school.[29] Previous analyses of BEACH data showed higher rates of test ordering among female GPs and in larger practices, and lower rates among older GPs.[30,31] To those recognised associations, our study adds practice accreditation and high workload (11 + sessions per week) as

5 Rate ratios for general practice and GP characteristics in an adjusted model predicting pathology test-ordering rates*

	Rate ratio (95% CI)	*P*
General practices		
Co-located with pathology collection centre	0.98 (0.93–1.05)	0.56
Located in Sydney (reference, Melbourne)	0.90 (0.86–0.94)	< 0.001
Size (reference, solo)		
2–4 GPs	1.06 (0.98–1.14)	0.13
5–9 GPs	1.11 (1.03–1.20)	0.006
10–14 GPs	1.15 (1.04–1.26)	0.004
15 + GPs	1.03 (0.91–1.16)	0.65
Practice accredited	1.12 (1.07–1.18)	< 0.001
GPs		
Female	1.12 (1.08–1.17)	< 0.001
Age (reference, < 35 years)		
35–44 years	0.96 (0.90–1.03)	0.26
45–54 years	0.89 (0.83–0.95)	0.001
55 + years	0.78 (0.72–0.84)	< 0.001
Sessions per week (reference, < 6)		
6–10	1.05 (1.00–1.10)	0.06
11 +	1.09 (1.01–1.17)	0.02
Country of graduation (reference, Australia)		
United Kingdom, Ireland, New Zealand	1.10 (1.00–1.21)	0.06
Other	0.96 (0.91–1.01)	0.13
Fellow of the RACGP	0.99 (0.95–1.04)	0.75

GP = general practitioner. RACGP = Royal Australian College of General Practitioners. * Covariates in the model include patient and encounter variables shown in Box 2 and dummy variables for each Bettering the Evaluation and Care of Health survey year. ◆

positive predictors; we also found that test-ordering rates were about 10% higher in Melbourne than in Sydney.

A strength of our study is that we used BEACH data, which have important advantages over Medicare data for measuring rates of pathology test ordering. Most notably, the federal government's "coning" rule for reimbursement confines Medicare data to the three most expensive pathology items ordered in any GP–patient episode of care. The reliability and validity of the BEACH methods have been tested and described elsewhere.[32]

A limitation of our study is that we used co-location as a marker of the closeness of relationships between GPs and pathology companies and, by inference, the scope for illegal or unethical commercial relationships. This is an excellent marker in theory, but the extent to which it is so in practice is unknown. In addition, we measured the number of pathology tests that GPs ordered, not the clinical appropriateness of those tests.

In summary, we found no evidence that co-location of general practices and PCCs affects GPs' test-ordering behaviour. From a policy perspective, the result suggests that the convenience of PCC co-locations for patients, particularly patients who have ambulatory problems or lack access to transportation, is not gained at the expense of undue influences on pathology test-ordering behaviour. However, our findings do not close the book on questions about the structure of pathology services in Australia generally, or over-testing in particular. Several recent trends are noteworthy, namely: the spread of GP Super Clinics, portending further integration of primary care and diagnostic services;[33] the discontinued agreement between the federal government, pathologists and pathology companies over caps on the growth of pathology services;[34] the federal government's loosening of PCC licensing rules;[35] and the looming prospect of larger out-of-pocket pathology costs for patients.[28] Together, these developments suggest that the need to better understand drivers of variation in test-ordering behaviour, and what constitutes cost-effective use of pathology services, is even more pressing today than it was when Deeble and Lewis-Hughes sounded the call two decades ago.[5]

ACKNOWLEDGEMENTS

We thank Adrian Minson and April Mori for research assistance. Paul Monagle and Marie Pirotta helped conceive the study idea and provided valuable comments on an earlier draft of the manuscript. We also thank the GPs who participated in the BEACH program.

David Studdert was supported by an Australian Research Council Federation Fellowship. Lyle Gurrin was supported by a National Health and Medical Research Council Career Development Award.

During the data collection years used for this study, contributions to funding the BEACH program were made by: the Australian Government Department of Health and Ageing, the Australian Institute of Health and Welfare, the National Prescribing Service, the Australian Government Department of Veterans' Affairs, the Office of the Australian Safety and Compensation Council (Department of Employment and Workplace Relations), AstraZeneca, Roche, Janssen-Cilag, Merck Sharp and Dohme, Pfizer, sanofi-aventis, Abbott and Wyeth.

COMPETING INTERESTS

Helena Britt, Ying Pan, Salma Fahridin and Clare Bayram have conducted analysis of problems involving pathology testing on behalf of the Australian Association of Pathology Practices.

The Australasian Association of Clinical Biochemists paid travel and accommodation expenses for Clare Bayram to attend the Business of Pathology meeting and speak about pathology testing in primary care.

AUTHOR DETAILS

David M Studdert, LLB, ScD, MPH, Professor and Federation Fellow[1]
Helena C Britt, PhD, Associate Professor[2]
Ying Pan, BMed, MCH, Senior Research Analyst[2]
Salma Fahridin, BAppSc(HIM), MHSc(CDM), Research Officer[2]
Clare F Bayram, BAppSc(HIM)(Hons), Research Officer[2]
Lyle C Gurrin, PhD, Associate Professor[1]

1 Melbourne School of Population Health, University of Melbourne, Melbourne, VIC.
2 Family Medicine Research Centre, School of Public Health, University of Sydney, Sydney, NSW.

Correspondence: d.studdert@unimelb.edu.au

REFERENCES

1 Medicare Australia. MBS group statistics reports. https://www.medicareaustralia.gov.au/statistics/mbs_group.shtml (accessed Mar 2010).

2 PricewaterhouseCoopers. International review of pathology funding arrangements: March 2010. http://www.hirc.health.gov.au/internet/main/publishing.nsf/Content/20CBB30C457BEB1DCA2576D300822677/$File/PwC_DoHAPathologyReview_180310_FINAL.pdf (accessed 2 Jun 2010).

3 Bayram C, Valenti L. GP pathology ordering. In: Britt H, Miller GC, editors. General practice in Australia, health priorities and policies 1998 to 2008. General practice series no. 24. Canberra: Australian Institute of Health and Welfare, 2009: 57-86. (AIHW Cat. No. GEP 24.) http://www.aihw.gov.au/publications/index.cfm/title/10721 (accessed Jun 2010).

4 KPMG. Review of the current arrangements for the regulation of approved (pathology) collection centres. Canberra: Department of Heath and Ageing, 2006. http://www.health.gov.au/internet/main/publishing.nsf/Content/health-pathology-leg-appaccs (accessed Mar 2010).

5 Deeble J, Lewis-Hughes P. Directions for pathology. National health strategy background paper no. 6. Canberra: Department of Health, Housing and Community Services, 1991.

6 Australian Government Department of Health and Ageing. Report of the review of Commonwealth legislation for pathology arrangements under Medicare. Final report, December 2002. http://pandora.nla.gov.au/pan/10941/20031108-0000/www.health.gov.au/haf/branch/dtb/review.pdf (accessed Jun 2010).

7 Phillips Fox. Review of the enforcement and offence provisions of the Health Insurance Act 1973 as they relate to the provision of pathology services under Medicare. 25 January, 2005. www.health.gov.au/internet/wcms/publishing.nsf/Content/health-pathology-leg-index.htm (accessed Mar 2010).

8 Medew J. Pathology rorts face new probe. *The Age* (Melbourne) 2008; 5 Apr. http://www.theage.com.au/news/national/pathology-rorts-face-new-probe/2008/04/04/1207249461184.html (accessed Mar 2010).

9 *Health Insurance Amendment (Inappropriate and Prohibited Practices and Other Measures) Act 2007* (Cwlth). No. 88, 2007.

10 Urban R. Probe into pathology kickbacks. *The Australian* 2010; 27 May.

11 Urban R. Showdown for pathology rivals in bribery case. *The Australian* 2010; 5 May.

12 Britt H, Miller GC, Charles J, et al. General practice activity in Australia 2008–09. Canberra: Australian Institute of Health and Welfare, 2009. (AIHW Cat. No. GEP 25.) http://www.aihw.gov.au/publications/index.cfm/title/11013 (accessed Mar 2010).

13 WONCA International Classification Committee. ICPC-2: international classification of primary care. 2nd ed. Oxford: Oxford University Press, 1998.

14 Britt H. A new coding tool for computerised clinical systems in primary care — ICPC plus. *Aust Fam Physician* 1997; 26 Suppl 2: S79-S82.

15 Medicare Australia. Approved collection centres. http://www.medicareaustralia.gov.au/apps/notesweb/acc.nsf/ACCPDFAttach/PDF/$File/ACCList.pdf?OpenElement (accessed Mar 2010).

16 Australian Bureau of Statistics. Australian standard geographical classification (ASGC), Jul 2009. Canberra: Commonwealth of Australia, 2009. (ABS Cat. No. 1216.0.) http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/1216.0Jul%202009?OpenDocument (accessed Mar 2010).

17 Kish L. Survey sampling. New York: John Wiley and Sons, 1965.

18 Wazana A. Physicians and the pharmaceutical industry. Is a gift ever just a gift? *JAMA* 2000; 283: 373-380.

19 Lurie N, Rich EC, Simpson DE, et al. Pharmaceutical representatives in academic medical centers. *J Gen Intern Med* 1990; 5: 240-243.

20 Caudill TS, Johnson MS, Rich EC, McKinney WP. Physicians, pharmaceutical sales representatives and the cost of prescribing. *Arch Fam Med* 1996; 5: 201-206.

21 Sondergaard J, Vach K, Kragstrup J, Andersen M. Impact of pharmaceutical representative visits on GPs' drug preferences. *Fam Pract* 2009; 26: 204-209.

22 Vancelik S, Beyhun NE, Acemoglu H, Calikoglu O. Impact of pharmaceutical promotion on prescribing decisions of physicians in Eastern Turkey. *BMC Public Health* 2007; 7: 122.

23 Adair RF, Holmgren LR. Do drug samples influence resident prescribing behavior? A randomized trial. *Am J Med* 2005; 118: 881-884.

24 Peay MY, Peay ER. The role of commercial sources in the adoption of a new drug. *Soc Sci Med* 1988; 26: 1183-1189.

25 Orlowski JP, Wateska L. The effects of pharmaceutical firm enticements on physician prescribing patterns. *Chest* 1992; 102: 270-273.

26 Bowman MA, Pearle DL. Changes in drug prescribing patterns related to commercial company funding of continuing medical education. *J Contin Educ Health Prof* 1988; 8: 13-20.

27 Gagnon M, Lexchin J. The cost of pushing pills: a new estimate of pharmaceutical promotion expenditures in the United States. *PLoS Med* 2008; 5: e1. doi: 10.1371/journal.pmed.0050001.

28 Creswell A. Pathology labs avoid bulk-billing. *The Australian* 2009; 29 Aug. http://www.theaustralian.com.au/news/pathology-labs-avoid-bulk-billing/story-e6frg6no-1225767255566 (accessed Mar 2010).

29 Taylor PT. Some fundamental influences on the pathology requesting behaviour of Victorian general practitioners — preliminary study results. *Pathology* 1994; 26: 33-35.

30 Britt H, Miller GC, McGeechan K, Sayer GP. Pathology ordering by general practitioners in Australia 1998. Canberra: Department of Health and Aged Care, 1999.

31 Britt H, Knox S, Miller GC. Changes in pathology ordering by GPs in Australia 1998–2001. Canberra: Australian Institute of Health and Welfare, 2003.

32 Britt H, Miller G, Bayram C. The quality of data on general practice — a discussion of BEACH reliability and validity. *Aust Fam Physician* 2007; 36: 36-40.

33 Australian Government Department of Health and Ageing. A national health and hospitals network for Australia's future — delivering better health and better hospitals. http://www.yourhealth.gov.au/internet/yourhealth/publishing.nsf/content/home (accessed Mar 2010).

34 Ryan S. Razor gang targets pathology test costs. *The Australian* 2009; 6 Apr.

35 Australian Government Department of Health and Ageing. Health Budget 2009–2010. Increasing competition in pathology and diagnostic imaging. http://www.health.gov.au/internet/budget/publishing.nsf/Content/budget2009-hmedia15.htm (accessed Mar 2010).

(Received 1 Apr 2010, accepted 9 Jun 2010) ❑