Changes in pathology ordering by general practitioners in Australia, 1998 to 2001

GP Statistics and Classification Unit

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The General Practice Statistics and Classification Unit is a collaborating unit of the Australian Institute of Health and Welfare and the University of Sydney, situated within the Family Medicine Research Centre at Westmead Hospital. It fulfils the obligation of the Australian Institute of Health and Welfare to collect statistics regarding general practitioners, their patients and their patients' care.

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Changes in pathology ordering by general practitioners in Australia 1998–2001

Helena Britt, Stephanie Knox & Graeme C. Miller

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Foreword

Pathology is the scientific study of disease and as such underpins most of medicine. Pathology tests are now a common part of modern medical practice and are used to screen for, confirm, exclude and monitor disease.

Over many years in Australia pathology test utilisation has grown at a rate far in excess of other medical activity. Tests are recorded in the Medicare database, allowing us to count the use of pathology service for all Australian citizens. In turn this allows us to investigate relationships of pathology testing with age, sex, state, place of residence, circumstances of collection/hospital status etc. Medicare data can also provide us with some information about the characteristics of the medical practitioners requesting pathology tests.

Unfortunately the Medicare data are deficient in two vital aspects. In most cases the Medicare item number used for claiming does not specifically identify individual pathology tests, a single item often covering a number of like tests. Secondly there is no documentation of the reason for the pathology test request. Analysis of the highly significant growth that has occurred in Medicare pathology item claims therefore is confounded by not knowing which specific tests are being performed more often and why they are being requested. Much speculation has occurred around the 'Drivers of Growth' for pathology test usage but there is little evidence that this has improved our understanding of what is a complex and confusing phenomenon.

Both the increased frequency of initiating an episode of pathology testing and the increased number of tests per episode are continuing to be a matter of great concern to Government and the providers of pathology testing services. Finding out more about the 'Drivers of Growth' is therefore vital for the future of this essential part of modern medicine.

This report from the BEACH program, on growth in pathology test requests by general practitioners, helps answer some of the unanswered questions. An earlier study from the BEACH program, *Pathology Ordering by General Practitioners in Australia 1998*, described the relationship between pathology test ordering and the characteristics of the GPs and patients. As well as the basic patient demographic associations (age, sex, place of residence etc) already demonstrated through analysis of the Medicare database, for the first time pathology test use was linked to clinical information (the problem being managed). As would have been predicted there was marked variation in individual and total test use depending on the patient's condition but the relationships were often unanticipated. The variation in requesting rate by GPs was strongly influenced by GP demographic factors (age, sex, participation rate, area of practice, practice size etc). Much of this information had never been previously described and was therefore of great value. However the data represented a cross-sectional 'snapshot in time' of GP pathology test ordering over a nine month period.

This study concentrates on changes in pathology ordering by GPs over a 3 year period, from 1998 to 2001. It has identified many factors associated with this growth in pathology test utilisation. The evidence indicates the increase is not a random unpredictable process but is being driven by patient and GP factors and by changes in medical practice in Australian health care delivery.

This study will better inform the debate on pathology test utilisation. It will also enable accurate predictions of growth of pathology test use and development of appropriate interventions to change growth rates.

Dr Michael Harrison, FRCPA

Chair

Quality Use of Pathology Committee

Department of Health and Ageing

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Summary

Background

There has been an increase in the number of pathology tests claimed by pathologists per episode in recent years. The extent to which this reflects a change in the ordering behaviour of general practitioners (GPs) and the extent to which any such change relates to changes in the characteristics of practicing GPs and/or other factors has been questioned.

Aims

To describe changes in the pathology-ordering behaviour of GPs and to investigate the extent to which these changes are related to changes in the characteristics of the GP population, the morbidity under management, other management behaviour and the length of consultation.

Method

A secondary analysis of data from the BEACH (Bettering the Evaluation and Care of Health) program, a continuous study of general practice activity from the three years April 1998–March 2001.

A random sample of GPs who claimed at least 375 general practice Medicare items of service in the previous 3 months is regularly drawn from the Health Insurance Commission data by the General Practice Branch of the Department of Health and Ageing. GPs are approached by letter and followed up by telephone recruitment. Each participating GP completes details about 100 consecutive patient encounters on structured paper encounter forms and provides information about themselves and their practice. Data elements include details of the encounter (including Medicare item number where applicable), patient characteristics, morbidity managed, and for each problem the pathology tests (up to five per encounters) and imaging ordered, the medications prescribed, advised or supplied, clinical treatments and therapeutic procedures.

Each GP also provides information about themselves and their practice, and these data form the basis of the analysis of change in GP characteristics over time.

The samples used for the current study were April 1998–March 1999 (98,400 encounter records from 984 GPs), 1999–2000 (104,700 encounters from 1,047 GPs) and 2000–01 (99,900 encounters from 999 GPs).

Statistical methods

GP weights were calculated by standardising the sample of GPs against the population of Australian GPs. Encounter weights were based on GP age, sex and activity level. Weights were applied when estimating population parameters.

Conventional simple random sample statistical methods were used for GP-based analyses. These included tests for categorical data and linear regression for ordinal or numeric outcomes.

Cluster samples violate the assumptions of simple random sample designs as the encounters for each GP were not independent of each other. Therefore the significance tests for encounter-based analyses were corrected for the design effect of the cluster sample, using methods incorporated into SAS version 8.2.

Changes in GP characteristics over time were tested with the chi square statistic.

Results

After post-stratification weighting for GP age (within sex) and activity level there were 96,901 encounters in 1998–99, 104,856 in 1999–00 and 99,307 in 2000–01. Total pathology test orders numbered 23,872 in 1998–99, 27,613 in 1999–00 and 29,225 in 2000–01.

Changes in pathology ordering rates

Between 1998–99 and 2000–01 there was a significant increase in the overall rate of pathology tests ordered, from 24.6 per 100 encounters to 29.4 per 100 encounters, an increase of 4.8 test orders per 100 encounters, or 19.5%. This increase was not due to any increase in the number of problems managed at encounter. Pathology test orders per 100 problems managed increased by 3.1 test orders, or 17.4%, from 17.8 per 100 problems managed to 20.9 per 100.

Pap smears represent a preventive procedure encouraged in general practice and the community, and they are conducted far more often by female GPs. Hence their inclusion in the analysis may have not been appropriate, as patterns of their ordering would have influenced total order rates. When Pap smears were excluded, the increase in ordering was still apparent, from 23.1 per 100 encounters to 28.0 per 100 (an increase of 4.9 per 100 encounters, or 21.2%) and from 16.3 per 100 problems to 19.9 per 100 (an increase of 3.6 test orders per 100 problems, or 22.1%). The remainder of this report is based on pathology test orders after the removal of Pap smears from the analysis. There was no real change in the proportion of encounters generating one or more pathology test orders but there was a small though significant increase in the likelihood of GPs ordering at least one test for a problem managed, from 9.1% in 1998–99 to 9.7% in 2000–01 ($p=0.006$).

Where pathology was ordered, there was an increase in the number of tests ordered for each problem, from 180 per 100 tested problems in 1998–99 to 205 per 100 in 2000–01, an average increase of 14.5 tests per 100 tested problem, per year. This result reflected an overall move to multiple test orders and away from ordering a single test for the problem.

The types of tests ordered

When the pathology tests ordered were considered in terms of the more common Medicare Benefits Schedule (MBS) pathology groups for general practice, it was apparent that the major increase in order rates was in the Chemical pathology class, from 11.3 per 100 encounters in 1998–99 to 15.4 per 100 in 2000–01, an increase of 36.3% ($p<0.0001$). Tests classed as Haematology also increased but to a lesser extent, from 5.1 to 5.7 per 100 encounters in 2000–01, an increase of 11.7% ($p=0.0093$). Linear regression analysis suggested that there had been a significant but marginal increase in order rates for Histopathology ($p=0.0160$) and a small but significant decrease of 0.1 test per 100 encounters in tests classed as Infertility ($p<0.0001$). There were no other MBS pathology groups for which order rates changed significantly over the period of the study.

The top sixteen test types accounted for 75% of all pathology tests. Significant increases in order rates were apparent for full blood counts, lipid tests, glucose, electrolyte, urea and creatinine (EUC) tests, multibiochemical analysis and hormone assays. Order rates for erythrocyte sedimentation rate (ESR), urine microscopy, culture and sensitivity (MC&S), and hepatitis/serology remained constant over time.

Characteristics of the GPs

The characteristics of GPs participating in the BEACH program have changed significantly over time and but most of these differences disappeared after post-stratification weighting for the known under-representation of young (<35 years) GPs in the sample compared with the total GP population. Changes in characteristics of the total sample frame (represented by the weighted data) were a significant increase in the proportion of GPs who graduated outside Australia (from 21.7% to 25.0%) and a significant change in distribution across states (though the pattern of change over the years was not clear). While the sample of participating GPs was significantly older in 2000–01 than in 1998–99, this difference disappeared after post-stratification weighting. We can conclude that the GP population as a whole was not significantly older in the latest year than in the earliest year of the study.

The relationship between GP characteristics and pathology ordering rates

GP sex: Female GPs were significantly more likely to order at least one pathology test than their male counterparts and this was confirmed as significant by linear regression. Female GPs had significantly higher pathology test rate of 21.2 orders per 100 problems managed than males (17.3 per 100). However, once the decision was made to order pathology there was no difference in the number of tests ordered per 100 tested problems.

GP age: Linear regression demonstrated a significant inverse relationship between GP age and pathology ordering rates. However, the relationship was not strictly linear. GPs aged 35–44 years had the highest pathology ordering rate (30.4 tests per 100 encounters) and those aged 55 years or more the lowest (22.0 per 100). GPs aged less than 35 years ordered significantly more tests than those aged 45 years or more but about the same as those of 35–44 years. After the decision to order pathology was made there was a steady and significant inverse linear relationship between the age group of the GP and the number of tests. GPs aged less than 35 years ordered 206 per 100 tested problems and the rate steadily decreased with GP age group to 180 per 100 problems managed for GPs of 55 years or more.

Size of practice: There was a significant linear relationship between the size of the practice and pathology test ordering rates—the larger the practice the higher the rate, solo GPs ordering 22.5 tests per 100 encounters and those in larger group practices of 5 or more GPs 28.8 tests per 100 encounters. GPs did not differ according to their practice size in the average number of tests ordered once the decision to place an order had been made.

Practice location: GPs practising in rural and remote areas had a significantly higher pathology ordering rate (29.9 per 100 encounters) than those working in urban areas (25.7 per 100). There were no significant differences in the pathology ordering rates between states and territories.

Multiple regression found that the higher rates of pathology orders among female GPs applied across all age groups and in each of the three years of the study. Decreased pathology ordering with increasing GP age was also demonstrated to be true for all three years of the study and for both sexes. However, there remained an increase in pathology ordering over time that was not accounted for by GP age and sex.

The purpose for which pathology tests were ordered

There was a small change in the overall distribution of the pathology tests over time, which resulted in a significant decrease in the proportion of pathology tests classed as *monitoring* pathology (from 41.3% to 37.1%). The 22% overall increase in the relative rate of pathology test orders was reflected in significant increases in all pathology classes—*diagnostic pathology*, *monitoring pathology*, *preventive care pathology* and *other pathology*. It was reflected well in the increase in diagnostic pathology (increase of 26%) and preventive care pathology (26%) but not in *monitoring pathology* (13%). The increase in *other pathology* (tests connected to ill-defined labels) rose at double the average rate (41%).

The problems for which pathology tests were ordered

There were five commonly managed problems with significant increases in pathology ordering rates between 1998–99 and 2000–01: hypertension (from 11.9 to 20.4 test orders per 100 contacts), diabetes (from 47.5 to 60.1), menopausal symptoms (from 17.5 to 28.2), ischaemic heart disease (from 22.4 to 33.1 per 100 problem contacts) and cardiovascular check-ups (from 10.8 to 17.2 per 100 problem contacts).

Multiple regression was used to investigate the relationship between problem types, pathology ordering rates and time. The results demonstrated that there had been a significant increase in pathology ordering rates for lipid disorders, thyroid problems and weakness/tiredness which had a considerable impact on total pathology tests ordered and reflected the overall increase in pathology ordering. However, increases in pathology test ordering rates for all blood pressure problems, other cardiovascular morbidity and diabetes were significantly greater than the overall increase, indicating an accelerated change in the pathology ordering for each of these problems. As their rate of management is high, the impact on total pathology test orders would be considerable. For lipid disorders and diabetes there were also increased management rates, producing an additive effect on the total pathology ordered for these problems over time. Together, increases in pathology test orders plus or minus increases in management rates for cardiac check-ups, diabetes, hypertension, menopausal symptoms and ischaemic heart disease explained an additional 1.5 million test orders nationally in 2000–01 compared with 1998–99.

The relationship between pathology test orders and other management

Prescribing: There was a significant inverse relationship between pathology test ordering and prescribing, such that the more pathology tests ordered for a problem, the fewer prescriptions. However, this did not result in a significant decrease in the total number of medications prescribed at all encounters over time.

Imaging: There was a significant positive relationship between imaging order rates and pathology ordering rates. There was also a significant increase in rates of imaging orders over time. It is unlikely that there is a direct causal relationship between imaging and pathology orders however, the same underlying factors that influence pathology ordering rates may also affect imaging order rates.

Therapeutic procedure: Linear regression demonstrated an inverse relationship between therapeutic procedures and pathology rates ($p<0.0001$), the more pathology, the fewer therapeutic procedures. However, this did not result in a significant decrease in the number of therapeutic procedures recorded over time.

Clinical treatments: Multiple regression showed no relationship between the number of pathology tests ordered and provision of clinical treatments (e.g. advice and counselling). A significant increase in rates of provision of clinical treatments from 21.6 to 25.8 per 100 in 2000–01 ($p<0.0001$) was not related to pathology ordering.

The relationship between pathology test orders and length of consultation

There was no significant change in the distribution of Medicare A1 items of service (Levels A, B, C, D) over the study period. However, there was a strong linear relationship between Medicare item level and pathology test ordering rates, the rate increasing from about 8–10 pathology test orders per 100 encounters claimable at Level A, to 60–70 test orders for encounters claimable at Level D. The Medicare item level remained a significant predictor of pathology ordering rates after adjusting for the problems managed. These findings were supported by a demonstrated significant relationship between consultation length (in minutes) and pathology test ordering, even after adjustment for the number of problems managed at the encounter.

Factors predicting pathology ordering rates

Simple linear regression demonstrated that the significant univariate predictors of pathology when fitted alone were:

- GP sex
- GP age
- place of graduation
- years in general practice
- size of practice location (both state/territory and urban/rural)
- sessions per week
- sex of patients
- proportion of patients aged less than five years, 5–14 years and 45–64 years
- management rates of most types of problems (with the exception of those associated with the ear, the eye, the musculoskeletal and neurological systems)
- Medicare item level claimed *and*
- duration of encounter.

Multiple regression identified the independent predictors of pathology ordering rate. The final model explained 31.9% of the variance in pathology ordering rates. After adjusting for all other significant factors, higher ordering rates were associated with GPs:

- in larger practices
- in rural and remote practices
- with higher proportions of working-age adult patients (15–64 years)

- with higher management rates of problems associated with the blood and blood-forming organs, the endocrine and metabolic system, the circulatory and urinary systems and those related to pregnancy and family planning *and*
- with higher rates of Medicare Level C consultations.

However, after adjustment for all these factors there remained an unexplained increase in pathology ordering rates over time.

Conclusion

There was a significant increase in pathology test ordering rates by GPs between 1998–99 and 2000–01. There was a relatively small increase in the proportion of problems for which pathology was ordered but there was a move away from ordering a single test per problem to ordering 3 or more tests per episode. The major increase was in orders for Chemical pathology followed by Haematology, with a smaller but significant increase in Histopathology. The increases are reflected in pathology ordered for all purposes, particularly for diagnostic and preventive care and other pathology, and to a lesser extent in monitoring pathology.

While order rates are significantly related to GP characteristics, there has been no change in the characteristics of practising GPs so this relationship cannot be the cause of increased pathology test orders. Some of the increase can be explained by increased management rates of a few common conditions. However, the majority of the measured increase cannot be explained by factors measured in this study. External influences such as the introduction of new MBS item numbers, system changes such as increased computerisation and possibly increased fear of litigation must be considered as possible influences on pathology ordering rates of GPs over the period of this study.

1 Introduction

1.1 Background

Between 1993–94 and 1997–98 the number of pathology services provided in Australia increased by almost 10 million, or 22%. Per person use of pathology services increased by 16% to 2.8 services per year.[1]

Between 1998–99 and 2000–01 pathology services in Australia cost the Commonwealth Department of Health and Ageing, through the Medicare program, more than one billion dollars per year. Over the three years of the study, the number of pathology items claimed through Medicare increased by almost 12% and total costs of these services increased by 150 million dollars or 14.7%, an average increase of 7.4% per year, and per capita use of pathology services increased by 23%. In contrast, while the total costs of general practitioner non-emergency services increased by 8.1% between 1998–99 and 2000–01, the annual number of services per capita decreased from 4.7 to 4.5 services per person over this period.

The increase in the number and cost of pathology tests to Medicare has not been consistent across Medicare Benefits Schedule (MBS) pathology groups. The greatest relative increase in the number of tests was in the MBS group Chemical pathology (a 22.6% increase between 1998–99 and 2000–01) and this group account for approximately one third of all pathology. This was followed by the increase in Immunology (20.1%). Increases in tests classed as Tissue pathology (10.7%) and Haematology (13.5%) reflected the average overall increase, while increases in Microbiology (5.5%), Cytogenetics (0.5%) and Infertility/pregnancy tests (1.5%) were well below average. There was a considerable decrease in the number of Simple basic tests (down by 11.0%) and a small decrease in the number of Cytopathology tests (down by 1.2%) claimed through Medicare over this period.[2]

General practitioners (GPs) are among the largest pathology users, ordering 70% of all pathology services claimed in 1999–00.[3] However, the increases in the number and cost of pathology tests as recorded by the Health Insurance Commission (HIC) data do not necessarily reflect the true ordering patterns of general practitioners.

- The data reported for pathology on the HIC's website count the number and cost of tests paid for by Medicare to the pathologists, irrespective of who placed the order for the test. This means that the total tests and total costs reported reflect those for all physicians, not just general practitioners.
- Each pathology company can respond differently to a specific test order label recorded by the GP. Further, the pathology companies can charge through the MBS only for the three most expensive tests undertaken, even where more were actually undertaken. This is called 'coning' and is part of the MBS pathology payment system.
- The second factor which distorts the HIC data in terms of its ability to reflect any changes in the pathology-ordering behaviour of GPs over time is called 'bundling'. Pathology MBS items often 'bundle' pathology tests into groups on the basis of cost. An item number may therefore not give a clear picture of the precise tests performed.

The effect of these factors is that the MBS pathology data include only those tests billed to the MBS after interpretation of the order by the pathologist and after selection of the three most expensive tests. This effect will not be random. For example, in an order for four tests to review the status of a patient with diabetes it is likely that the HbA1c will be the least expensive and will 'drop off' the billing process due to coning. This would result in an underestimate of the number of HbA1c tests being ordered by GPs.

In light of the increase in pathology tests and the total costs of pathology reported above, we were interested in the extent to which these increases reflect increased pathology ordering by GP. If changes were found in the number or types of tests ordered by GPs over this period we were also interested to investigate possible relationships between such changes and any changes in the characteristics of the GPs, characteristics of the patients and morbidity manage.

Bettering the Evaluation and Care of Health (BEACH), a continuous national study general practice activity, provides an ideal data source from which these questions could be answered. It began in April 1998 and involves a rolling random sample of 1,000 GP per year (about 20 per week) who each record details regarding 100 consecutive patient encounters on structured paper encounter forms. BEACH allows the analysis of relationships between pathology ordered and GPs' characteristics, patients' characteristics, problems managed and other management techniques used when pathology is ordered by general practitioners.[4-6] BEACH reflects the GP's intent that the patient has the pathology test(s) done and information as to the extent to which patients do not do so is not known.

There have been two previous reports of GPs' pathology-ordering behaviour based on national data. In 1990–91 the Australian Morbidity and Treatment Survey (AMTS) was undertaken by the, then, Family Medicine Research Unit of the Department of General Practice at the University of Sydney. In this study random sample, stratified by state, of 495 general practitioners throughout Australia each recorded data for two weeks on a rotating basis throughout the year. This study showed that a decade ago at least one pathology test was ordered at 12.8% of patient encounters. The test orders recorded in the AMTS had no structured linkage to the specific problem under management so no data pertaining to rates of pathology ordering for selected problems are available from this study. Specific tests ordered were not recorded, the GPs being given a series of tick boxes for blood, urine, culture, tissue.[7] Therefore multiple tests of one 'type' (e.g. blood tests) were counted as a single order event and total counts of the number of tests ordered are not possible.

The second study was a secondary analysis of data from the first nine months of the BEACH program, from April 1998 to December 1998 inclusive. This described the current ordering patterns of GPs and assessed these behaviours in light of available guidelines for pathology ordering. It also discussed available guidelines for pathology ordering in terms of their usefulness to GPs and for determining the quality use of pathology in both differentiated and undifferentiated conditions.[1]

In 2001–02, GPs ordered at least one pathology test at 14.0% of encounters, for one in every ten problems they managed, at a rate of 31.0 tests per 100 encounters.[8] Pathology test ordering rates and a description of the distribution of tests across MBS groups have been reported in each of the BEACH annual reports. However, these reports cover all aspects of the BEACH database and can only give a broad overview of any one aspect (such as pathology test orders) for the individual year of interest. In contrast, this report concentrates on the changes in pathology-ordering behaviour over time and investigates the possible causes of any changes identified.

1.2 Aims

This report aims to investigate changes in pathology ordering patterns in general practice between April 1998 and March 2001, and the possible relationships between any identified changes and other factors.

More specific aims are:

- to investigate changes in pathology ordering patterns over the three years of the program
- to investigate the extent to which characteristics of GPs have changed over the three years of the program and therefore potentially influenced pathology ordering patterns
- to investigate the relationships between:
  - changes in pathology ordering and in GP characteristics (particularly GP age)
  - pathology ordering and morbidity under management
  - pathology ordering and length of consultation
  - pathology ordering and prescribing behaviour, imaging ordered, therapeutic procedures undertaken and clinical treatments provided
- to investigate the factors that together significantly contributed to pathology-ordering behaviour.

2 Methods

This study is a secondary analysis of the BEACH data, collected in the three annual samples between April 1998 and March 2001 inclusive.

- Sample 1 = 1998–99, 98,400 encounters from 984 GPs.
- Sample 2 = 1999–00, 104,700 encounters from 1,047 GPs.
- Sample 3 = 2000–01, 99,900 encounters from 999 GPs.

2.1 BEACH methods

The methods adopted in the BEACH program have been described in detail elsewhere.[4,5 9] In summary, each of the recognised GPs in a random sample of approximately 1,000 per year records details about 100 doctor–patient encounters of all types. The information is recorded on structured encounter forms (on paper). It is a rolling sample, recruited approximately 3 weeks ahead. Approximately 20 GPs participate each week, 50 weeks a year.

Sampling methods

The source population includes all GPs who claimed a minimum of 375 general practice A1 Medicare items in the most recently available 3-month HIC data period. This equates with 1,500 Medicare claims a year and ensures inclusion of the majority of part-time GPs while excluding those who are not in private practice but claim for a few consultations a year. The General Practice Branch of the Commonwealth Department of Health and Ageing draws a sample on a regular basis.

Recruitment methods

The randomly selected GPs are approached initially by letter, then by telephone follow-up. GPs who agree to participate are set an agreed recording date approximately 3 to 4 weeks ahead. A research pack is sent to each participant about 10 days before their planned recording date. A telephone reminder is made to each participating GP in the first days of the agreed recording period. Non-returns are followed up by regular telephone calls.

Each participating GP earns 20–35 Clinical Audit points towards the quality assurance requirements of the Royal Australian College of General Practitioners (RACGP). As part of this quality assurance process, each receives an analysis of his or her results compared with those of nine other unidentified GPs who recorded at approximately the same time. Comparisons with the national average and with targets relating to the National Health Priority Areas are also made. In addition, GPs receive some educational material related to the identification and management of patients who smoke or who consume alcohol at hazardous levels.

Data elements

BEACH includes three interrelated data collections: encounter data, GP characteristics and patient health status. An example of the forms used to collect the encounter data and the data on patient health status is included in Appendix 1. The GP characteristics questionnaire is included in Appendix 2.

Encounter data include: date of consultation, type of consultation (direct, indirect), Medicare/Veterans' Affairs item number (where applicable) and specified other payment source (tick boxes). These data elements allow investigation of the relationship between pathology test ordering rates and MBS item number level for the majority of consultations.

Information about **the patient** includes date of birth, sex and postcode of residence. Tick boxes are provided for Health Care Card holder, Veterans' Affairs card holder, non–English-speaking background, and status of Aboriginal and/or Torres Strait Islander origin (self-identification). Space is provided for up to three patient reasons for encounter.

The **content of the encounter** is described in terms of the problems managed and the management techniques applied to each of these problems. Data elements include up to four diagnoses/problems. Tick boxes are provided to denote the status of each problem as new to the patient (if applicable) and if it was thought to be work-related.

Management data for each problem include medications prescribed, over-the-counter medications advised and other medications supplied by the GP. Details for each medication comprise brand name, form (where required), strength, regimen, status (if new medication for this problem for this patient) and number of repeats. Non-pharmacological management of each problem includes counselling and procedures, new referrals, and pathology and imaging ordered.

Pathology tests ordered by the GP are recorded in free text and may describe a battery of tests (such as a full blood count) or a single test (such as an erythrocyte sedimentation rate, ESR). Each test order can be related to a single problem or to multiple problems under management, and multiple tests can be linked to one problem managed at the encounter. This means there can be a one-to-one, one-to-many or many-to-one relationship between pathology tests ordered and problems managed. Up to five tests or batteries of tests can be recorded on each encounter form.

GP characteristics include age and sex, years in general practice, number of GP sessions worked per week, number of GPs working in the practice (to generate a measure of practice size), consultations in languages other than English, postcode of major practice address, country of graduation, postgraduate general practice training and Fellowship status (of the RACGP), after-hours care arrangements and use of computers in the practice.

Length of consultation in minutes is measured in a subsample of forms in years 1, 2 and 3 of the BEACH program. A second part of the BEACH program collects information about patient health and risk factors. This section is called SAND (Supplementary Analysis of Nominated Data) and it relies on GPs asking patients questions about specific aspects of their health. Between ten and twenty topics are covered in SAND each year (depending on the subsample size for each topic). However, there are three that are consistent across the whole year and in which all participating GPs are involved: body mass index, smoking status and alcohol consumption. In each pack of 100 encounter forms there are forty forms which include this SAND topic.

In years 2 and 3 these forms also included a place to record start and finish time of the consultation. This allows calculation of the length of the consultation for a subsample of about 40,000 encounters and investigation of the relationship between length of consultation in minutes and pathology test ordering rates.

The BEACH relational database

The BEACH relational database is described diagrammatically in Figure 2.1. Note that all variables can be directly related to GP and patient characteristics and to the encounter.

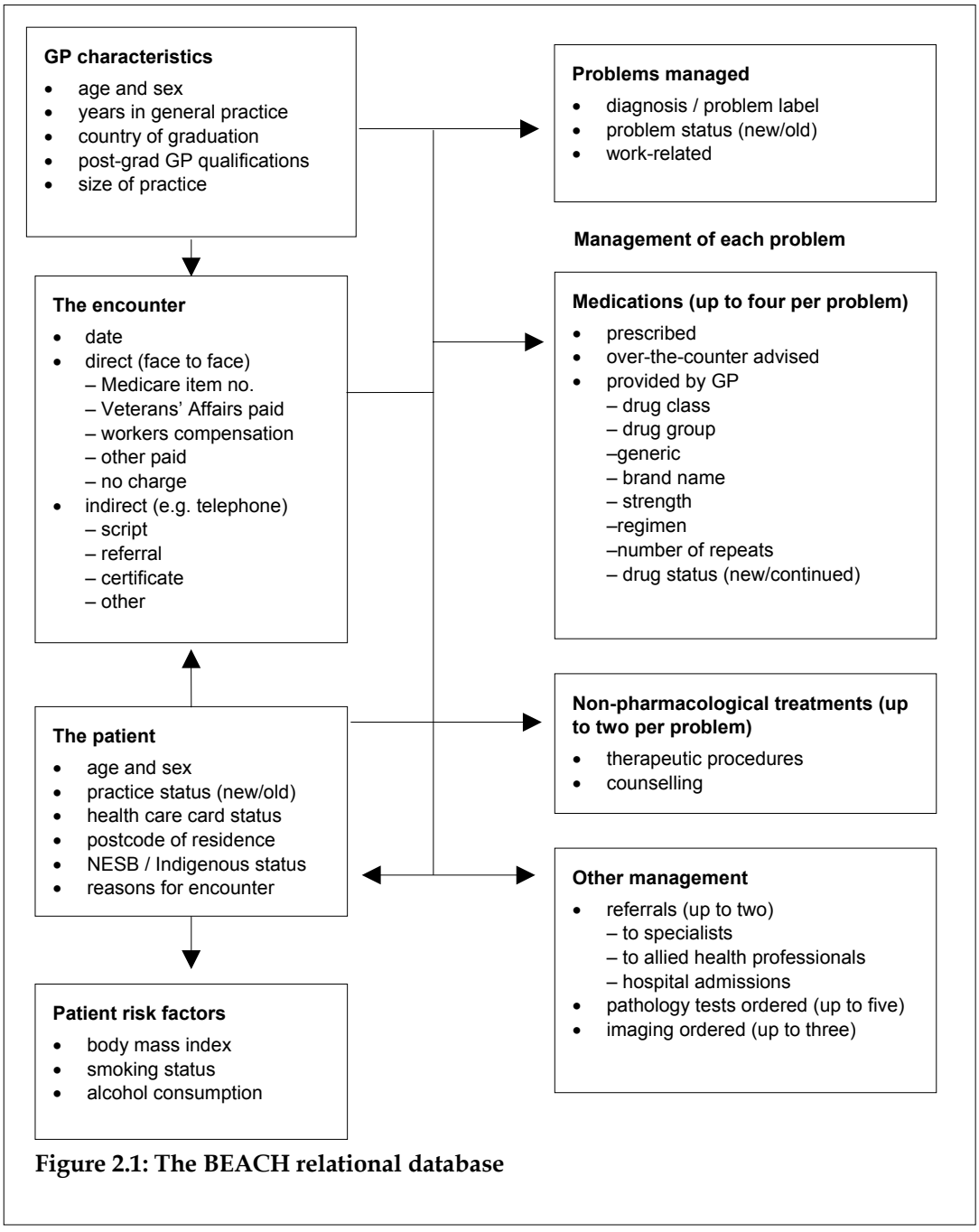


Figure 2.1: The BEACH relational database

Classification of data

The pathology tests ordered, imaging ordered, patient reasons for encounter, problems managed, procedures, other non-pharmacological treatments, referrals, pathology and imaging are coded using ICPC-2 PLUS.[10] This is an extended vocabulary of terms classified according to the International Classification of Primary Care–2nd edition (ICPC-2), a product of the World Organization of Family Doctors (WONCA).[11] The ICPC is used in over 45 countries as the standard for data classification in primary care.

A shown in Figure 2.2, the ICPC has a bi-axial structure, with 17 chapters on one axis (each with an alphabetic code) and seven components on the other (numeric codes). Chapters are based on body systems, with additional chapters for psychological and social problems.

- Component 1 includes symptoms and complaints.
- Component 7 covers diagnoses.

These are independent in each chapter and both can be used for patient reasons for encounter or for problems managed.

- Components 2 to 6 cover the process of care and are common throughout all chapters.

The processes of care, including orders for pathology and imaging, referrals and non-pharmacological treatments are classified in these process components of ICPC-2. Component 2 (diagnostic screening and prevention) is also often applied in describing the problem managed (e.g. check-up, immunisation).

	Chapters																
Components	**A**	**B**	**D**	**F**	**H**	**K**	**L**	**N**	**P**	**R**	**S**	**T**	**U**	**W**	**X**	**Y**	**Z**
1. Symptoms, complaints																	
2. Diagnostic, screening, prevention																	
3. Treatment, procedures, medication																	
4. Test results																	
5. Administrative																	
6. Other																	
7. Diagnoses, disease																	

A	General	L	Musculoskeletal	U	Urinary
B	Blood, blood-forming	N	Neurological	W	Pregnancy, family planning
D	Digestive	P	Psychological	X	Female genital
F	Eye	R	Respiratory	Y	Male genital
H	Ear	S	Skin	Z	Social
K	Circulatory	T	Metabolic, endocrine, nutritional		

Figure 2.2: The structure of the International Classification of Primary Care—2nd edition (ICPC-2)

The ICPC-2 is an excellent epidemiological tool. The diagnostic and symptomatic rubrics have been selected for inclusion on the basis of their relative frequency in primary care settings or because of their relative importance in describing the health of the community. It has only about 1,370 rubrics and these are sufficient for meaningful analyses. However,

reliability of data entry, using ICPC-2 alone, would require a thorough knowledge of the classification if correct classification of a concept were to be ensured. In 1995, recognising a need for a coding and classification system for general practice electronic health records, the Family Medicine Research Centre (then Unit) developed an extended vocabulary of terms classified according to the ICPC. These terms were derived from those recorded in more than half a million Australian GP–patient encounter forms. The terms have developed further over the past 6 years in response to the use of terminology by GPs participating in the BEACH program and in response to requests from GPs using ICPC-2 PLUS in their electronic clinical systems. This allows far greater specificity in data entry and ensures high inter-coder reliability between secondary coding staff. It also facilitates analyses of information about more specific problems when required.[10]

Coding and classification of pathology test orders.

When the BEACH program began in 1998 ICPC-2 PLUS had been developed to allow more specific coding of patient reasons for encounter and problems managed, as noted above. However, in the earlier years (pre-BEACH), encounter forms had not allowed GPs to record the specific types of tests ordered. They were simply offered a series of tick boxes (the options being blood, urine, culture, other) and multiple response was allowed. While this gave some indication of the broad types of tests ordered, it did not provide a list of terms used by GPs for the test type ordered, on which to base an extended terminology of PLUS terms for pathology.

Before the *BEACH* program was launched, the more commonly used pathology tests were identified through discussions with general practitioners and classified according to the ICPC-2 code as described above. Each specific test was given an extension code so that it could be individually identified during analyses. In the BEACH program the GPs were asked to enter the pathology test(s) ordered in free text and they were then secondarily coded according to this initial code set.

In year 3 of the program the General practice Statistics and Classification Unit was funded by the Diagnostics and Technology Branch of the (then) Commonwealth Department of Health and Aged Care to further develop this terminology in response to the terms actually used by GPs in the first two years of the program. The aim was to better reflect their ordering terminology in future years. This resulted in a more specific set of pathology test order codes in ICPC-2 PLUS. The year 3 pathology data from BEACH was double-coded, once in the old system and once in the new. This provided continuity of data through the first three years of the program using the old coding system and provided future continuity between year 3 and future years. Analysis in this report is therefore based on the first three years' data, using the old coding system.

Grouping pathology codes for analysis

Of particular interest to this study is ICPC Component 2—Diagnostic, screening and preventive procedures. This component includes seven rubrics relating to pathology orders. Each of these rubrics can be applied in 16 of the 17 chapters (that are based largely on body systems). They cannot be applied in the Social chapter of ICPC-2. The rubrics are:

- —32 Sensitivity test
- —33 Microbiological/immunological test
- —34 Blood test
- —35 Urine test

- —36 Faeces test
- —37 Histological/exfoliative cytology
- —38 Other laboratory tests NEC.

This means there are 112 possible ICPC codes available for the classification of pathology tests. While it is possible to report the pathology tests in terms of their ICPC-2 code, pathology tests and costs are usually reported in Australia in terms of MBS item numbers and groups of item numbers. The pathology tests were therefore reclassified according to the MBS and the group pathology data were analysed using these MBS categories:

- 01 Haematology
- 02 Chemical pathology
- 03 Microbiology
- 04 Immunology
- 05 Histopathology
- 06 Cytopathology
- 07 Cytogenetics
- 08 Infertility and pregnancy tests
- 09 Simple basic pathology tests
- 10 Other pathology test not elsewhere classified.

Grouping disease codes for the pathology analyses

The structure of ICPC-2 provides a natural basis on which to review the problems under management associated with pathology orders. However, some ICPC-2 codes have been grouped for the analyses in this report to improve statistical power for selected problems. For example, *arthritis* includes all arthritis codes (irrespective of site) not specified as osteoarthritis or rheumatoid arthritis. The codes used for each problem label included in this report are provided in Appendix 3.

Coding quality, validity and reliability

In the development of a database such as BEACH, data gathering moves through specific stages: GP sample selection, cluster sampling around each GP, GP data recording, and secondary coding and data entry. At each stage the data can be invalidated by the application of inappropriate methods.

All morbidity and management data elements are automatically coded and classified by the computer as secondary coding staff enter key words or word fragments and select the required term or label from a pick list. A quality assurance program to ensure reliability of data entry includes ongoing development of computer-aided error checks ('locks') at the data entry stage and a physical check of samples of data entered versus those on the original recording form. Further logical data checks are conducted through SAS statistical software on a regular basis.

Previous work has demonstrated the extent to which a random sample of GPs recording information about a cluster of patients represents all GPs and all patients attending GPs.[12] Other studies have reported the degree to which GP-reported patient reasons for encounter and problems managed accurately reflect those recalled by the patient[13] and the reliability of

secondary coding of reasons for encounter[14] and problems managed.[7] The validity of ICPC as a tool with which to classify the data has also been investigated in earlier work.[14]

Limitations regarding the reliability and validity of practitioner-recorded morbidity have been discussed elsewhere and should always be borne in mind. However, these apply equally to data drawn from medical records (whether paper-based or electronic) and to active data collection methods.[15,16] There is as yet no more reliable method of gaining detailed data about morbidity and its management in general practice. Further, irrespective of the differences between individual GPs in their labelling of problems, morbidity data collected by GPs in active data collection methods have been shown to provide a reliable overview of the morbidity managed in general practice.[17]

2.2 Statistical methods

The analysis of the BEACH database is conducted with SAS version 8.2[18] and the encounter is the primary unit of analysis. Proportions (%) are used only when describing the distribution of an event that can arise only once at a consultation (e.g. age, sex or item numbers) or to describe the distribution of events within a class of events (e.g. problem *A* as a percentage of total problems).

Changes in GP characteristics over time were tested with the chi square statistic. Where the p-value is less than 0.01 we can be 99% confident there has been a real and significant change in the GP characteristic. Where the p-value is less than 0.05 we can be 95% confident that the demonstrated change is real.

Rates per 100 encounters are used when an event can occur more than once at the consultation (e.g. reasons for encounter, problems managed or medications). Rates per 100 problems are used when a management event can occur more than once per problem managed. In general, the number of observations *(n)*, rate per 100 encounters and the 95% confidence intervals (CIs) are presented.

The BEACH study is essentially a random sample of GPs, each providing data about a cluster of encounters. Cluster sampling study designs in general practice research violate the simple random sample (SRS) assumption because the probability of an encounter being included is a function of the probability of the GP being selected.[19]

There is also a secondary probability function of particular encounters being included in the GP's cluster (associated with the characteristics of the GP or the type and place of the practice) and this increases the likelihood of sampling bias. In addition, there will be inherent relationships between encounters from the same cluster and this creates a potential statistical bias. The probability of gaining a representative sample of encounters is therefore reduced by the potential sampling and statistical bias, decreasing the accuracy of national estimates.

When a study design other than SRS is used, analytical techniques that consider the study design should be employed. In this report the standard error used in calculating the 95% confidence intervals adjusts for the effect of the single-stage clustered study design. Procedures in SAS V8.2[18] software were used that adjust for the design effect according to Kish's formulae.[20]

Post-stratification weighting was also applied to the raw data during analysis to improve the estimation of GP and encounter characteristics.

GP weights

Inferences about GP population characteristics from the BEACH sample can be improved by calculating weights that adjust for any undersampling or oversampling of particular groups of GPs. Weights are assigned by comparing the distribution of the sample against the distribution in the benchmark population on those characteristics that may influence the final results (eg: age group and sex). Weights are calculated as the proportion of each subgroup in the population divided by the proportion in the sample. Over-representation results in a weight less than one, under-representation in a weight greater than one.

When each observation is multiplied by its weight the weighted sample distribution will conform to the population distribution (standardisation). The weights are then used to adjust sample estimates to give a better representation of the true population value. Standardisation of each year's sample to the actual population of GPs allows comparisons across years that adjusts for differences in age–sex distribution across samples.

In BEACH, the characteristics of each year's sample of are compared with the Australian population of active recognised GPs for that year (HIC data). Sample weights are calculated to adjust for any differences in the age–sex distribution of the sample of GPs compared with the known age–sex distribution of the population of GPs.

Encounter weights

For encounter-based analyses an encounter weight was calculated from the GP weight multiplied by the GP's activity level (HIC data). A GP who claims more MBS item numbers in a year represents a larger proportion of total patient encounters than a GP who claims fewer item numbers. Therefore more active GPs are given a higher activity weight for their encounters than GPs who are less active. Encounter weights are used to provide better estimates of encounter rates for the total annual GP–patient encounters in Australia. Weighted estimates are calculated by multiplying the observation weight by the raw value of the characteristic of interest and summing the weighted values.[21]

Analyses with sample weighting

Each BEACH year involves a separate sample of GPs, and GP weights were calculated for each year.

When using a single year to estimate rates for any factor the weighted data are therefore used. For GP characteristics, GP weights were used. For encounter rates such as patient characteristics or problems managed, encounter weights were used.

Comparisons of the estimated GP population across the three years required standardising using the GP sample weights. Any comparison of estimates for all Australian GP–patient encounters required standardisation using encounter weights.

Analyses without sample weighting (unweighted)

Unweighted (raw) data were used to compare the GP samples from each year, to see if the actual samples were in fact significantly different from each other in terms of GP and practice characteristics. Sample weights are specific for each year's sample. Unweighted data were therefore also used for calculating rates for the combined three-year samples, where time was not a factor. For example, unweighted data were used in the investigation of the relationship between pathology rates and GP characteristics.

Statistical analysis

The outcome variable was pathology ordering, measured variously as rates per GP, per 100 encounters or per 100 problems managed, per cent of encounters or per cent of problems. The year of data collection, fitted as an ordinal variable (1, 2, 3) was used to test for trends in pathology ordering over time. Other potential predictors of pathology ordering included GP characteristics, practice characteristics, patient characteristics and morbidity managed.

SAS statistical software version 8.2[18] was used for statistical analyses. For encounter-based and problem-based analyses, methods were used that adjust for the design effect of the cluster sample. SAS version 8.2 incorporates procedures that calculate the robust standard error for cluster samples. The reported p-values and confidence intervals for encounter-based analyses are all calculated from the robust standard error adjusted for the cluster sample design.

The sample of GPs is a simple random sample design; therefore GP-based analyses used conventional statistical methods appropriate for simple random samples. Categorical variables such as GP characteristics were compared using chi-square statistics, rates and ordinal variables were analysed using linear regression.

General linear modelling with GP pathology ordering rates as the outcome variable was performed to find the independent predictors of GP pathology ordering over the three years of the program.

Effect modification

Any change in ordering rates over time could vary depending on the specific problem under management. Therefore, when analysing pathology rates for specific problems, time by problem interaction terms were created to test whether the type of morbidity managed modified the effect of time on pathology ordering rates (i.e. did the rate of change over time in ordering rates vary according to the particular problem under management?).

2.3 The final data sets

There were 984 GPs who participated in the BEACH program in 1998–99, 1,047 GPs in 1999–00 and 999 in 2000–01.

After post-stratification weighting (described above) there were 96,901 encounters in 1998–99, 104,856 in 1999–00 and 99,307 in 2000–01. Pathology test orders numbered 23,872 in 1998–99, 27,613 in 1999–00 and 29,225 in 2000–01. The baseline sample sizes for the remaining variables of interest to this study are presented in Table 2.1.

Table 2.1: Size of weighted data sets for each BEACH year, 1998–99, 1999–00, 2000–01

Variable	1998–99	1999–00	2000–01
Participating GPs	984	1,047	999
Encounter records	96,901	104,856	99,307
Problems managed	140,824	153,857	143,528
Pathology tests ordered	23,872	27,613	29,225
Pathology other than Pap smears ordered	22,399	26,060	27,771
Prescribed medications	90,710	98,372	91,647
Imaging tests ordered	6,844	7,841	8,227

3 Changes over time in GP pathology ordering rates

This Chapter investigates the extent to which the patterns of GP pathology orders changed between 1998–99 and 2000–01 in terms of:

- the rate of pathology orders per 100 GP–patient encounters
- the rate of pathology tests per 100 problems managed
- the proportion of encounters where at least one pathology test was ordered
- the proportion of problems for which at least one pathology test was ordered
- the distribution of number of tests ordered per encounter (0, 1, 2, 3, 4, 5 tests)
- the distribution of number of tests per problem (0, 1, 2, 3, 4, 5 tests).

Time was fitted as an ordinal variable, the year of data collection (1, 2, 3) to test for a linear trend over time.

For rates of pathology ordering per 100 encounters or per 100 problems and for at least one pathology test ordered, linear regression was used with each of the outcome measures fitted as the outcome variable.

For distribution of numbers of tests per encounter and per problem, the 95% confidence intervals for each time period are reported.

The initial analysis in Section 3.1 includes all pathology test orders. The analysis is then repeated after exclusion of Pap smears (Section 3.2).

3.1 Changes in total pathology ordering rates over time

Overview of pathology ordering rates over time

The first section of Table 3.1 demonstrates that between 1998–99 and 2000–01 there was a significant increase in the overall rate of pathology test orders per 100 encounters, from 24.6 per 100 in 1998–99 to 29.4 per 100 in 2000–01 ($p<0.0001$), an increase of 4.8 tests per 100 encounters, or 19.5% over two years.

Extrapolated to all GP–patient encounters across the country, this increase represents an additional 4.9 million pathology tests ordered by GPs in 2000–01 compared with 1998–99.

To test the extent to which this increase merely reflected an increase in the number of problem managed by GPs, the rate of pathology tests ordered per 100 problems managed was investigated. This rate also proved to have increased significantly, from 17.8 per 100 problems managed to 20.9 per 100 ($p<0.0001$), an increase of 3.1 test orders per 100 problems, or 17.4%. Investigation of the distribution of pathology test orders across encounters demonstrated there had been no change in the proportion of encounters for which no pathology was ordered over this period, this proportion remaining constant at about 86–87%. That is, there had been no increase in the likelihood of the GP ordering pathology at an encounter. This result suggested that, when pathology was ordered for a problem, more tests were being ordered on average per episode in 2000–01 than in 1998–99.

Rates of pathology tests orders per encounter

At encounters that generated pathology test orders, significant changes were apparent in the pattern of ordering (Table 3.1).

- The proportion of encounters at which a single pathology test was ordered decreased significantly over the three years, from 7.7% (95% CI: 7.4–8.0) to 6.7% (95% CI: 6.4–7.0), a decrease of 13%.
- There was no change in the proportion of encounters at which two pathology tests were ordered, remaining constant at 2.2%–2.4%.
- There was a significant increase in the proportion of encounters at which three, four and five tests were ordered, the changes being:
  - an increase in the proportion of encounters at which three tests were ordered, from 1.6% (95% CI: 1.5–1.7) in 1998–99 to 1.9% (95% CI: 1.8–2.1) in 2000–01, an overall increase of 19%
  - an increase in the proportion of encounters at which four tests were ordered, from 0.9% (95% CI: 0.8–1.0) in 1998–99 to 1.3% (95% CI: 1.2–1.4), an increase of 44%
  - an increase in the proportion of encounters at which five tests were ordered, from 0.8% (95% CI: 0.7–0.9) in 1998–99 to 1.4% (95% CI: 1.2–1.5), an increase of 75%.

This resulted in a significant increase in the mean number of pathology test orders per 100 encounters, from 186 per 100 in 1998–99 to 214 in 2000–01, an increase of 15.0% and an average annual increase of 14 pathology test orders per 100 tested encounters ($p<0.001$).

Rates of pathology tests orders per problem

Investigation of the distribution of pathology test orders across individual problem management demonstrated there was no change in the proportion of problems for which no pathology was ordered over this period, the proportion with no pathology remaining constant at about 89–90%.

However, where the GP did decide to order a pathology test. significant changes in the number of tests ordered for the problem under management were apparent.

- The proportion of problems generating a single pathology test decreased significantly over the three years, from 6.3% (95% CI: 6.0–6.5) to 5.7% (95% CI: 5.5–5.9), a decrease of 10%.
- There was a small but significant increase in the proportion of problems for which two pathology tests were ordered, from 1.7% (95% CI: 1.6–1.8) in 1998–99 to 1.9% (95% CI: 1.8–2.0) in 2000–01. This was an increase of 12%.
- There was also a significant increase in the proportion of problems for which three, four and five tests were ordered, the changes being:
  - a significant increase in the proportion of problems for which three tests were ordered, from 1.1% (95% CI: 1.0–1.2) in 1998–99 to 1.4% (95% CI: 1.3–1.5) in 2000–01 (an increase of 27%)
  - a significant increase in the proportion for which four tests were ordered, from 0.6% (95% CI: 0.6–0.7) in 1998–99 to 0.9% (95% CI: 0.8–1.0), an increase of 50%
  - a significant increase in the proportion for which five tests were ordered, from 0.4% (95% CI: 0.4–0.5) in 1998–99 to 0.8% (95% CI: 0.7–0.9), a 100% increase.

This increase was also reflected in the mean number of pathology tests ordered per 100 tested problems, from 173 per 100 in 1998–99 to 197 per 100 in 2000–01, representing an average annual increase of 12.1 tests per 100 tested problems ($p<0.001$). This represents an increase of 14%.

Table 3.1: Pathology ordering rates over time (annual weighted data)

Pathology test ordering measure	1998–99	1999–00	2000–01	Trend coefficient[(a)]	p-value
Pathology test rate per 100 encounters (95% CI)	24.6 (23.6–25.7)	26.33 (25.2–27.5)	29.4 (28.2–30.7)	2.40	<0.0001
Pathology test rate per 100 problems (95% CI)	17.8 (16.7–18.1)	18.4 (17.7–19.2)	20.9 (20.0–21.7)	1.76	<0.0001
At least one pathology test per encounter Per cent of encounters (95% CI)	13.2 (12.8–13.7)	13.8 (13.3–14.3)	13.8 (13.3–14.3)	0.26	0.113
At least one pathology test per problem Per cent of problems (95% CI)	10.0 (9.7–10.4)	10.4 (10.0–10.7)	10.6 (10.2–11.0)	0.28	0.027
Number of pathology tests per encounter Per cent of encounters (95% CI)	**1998–99**	**1999–00**	**2000–01**	**Direction of change**	
No pathology tests ordered (95% CI)	86.8 (86.3–87.2)	86.2 (85.7–86.7)	86.2 (85.7–86.7)	No change	
1 pathology test ordered (95% CI)	7.7 (7.4–8.0)	7.8 (7.5–8.2)	6.7 (6.4–7.0)	Decrease	
2 pathology tests ordered (95% CI)	2.2 (2.1–2.4)	2.2 (2.0–2.3)	2.4 (2.3–2.6)	No change	
3 pathology tests ordered (95% CI)	1.6 (1.5–1.7)	1.7 (1.6–1.9)	1.9 (1.8–2.1)	Increase	
4 pathology tests ordered (95% CI)	0.9 (0.8–1.0)	1.0 (1.0–1.1)	1.3 (1.2–1.4)	Increase	
5 pathology tests ordered (95% CI)	0.8 (0.7–0.9)	1.0 (0.8–1.1)	1.4 (1.2–1.5)	Increase	
Mean number of pathology tests per 100 encounters at which pathology ordered (95% CI)	186 (182–190)	191 (187–196)	214 (209–218)	Increase	
Number of pathology tests per problem Per cent of problems managed (95% CI)	**1998–99**	**1999–00**	**2000–01**	**Direction of change**	
No pathology tests ordered (95% CI)	90.0 (89.6–90.3)	89.6 (89.3–90.0)	89.4 (89.1–89.8)	No change	
1 pathology test ordered (95% CI)	6.3 (6.0–6.5)	6.4 (6.1–6.6)	5.7 (5.5–5.9)	Decrease	
2 pathology tests ordered (95% CI)	1.7 (1.6–1.8)	1.8 (1.7–1.9)	1.9 (1.8–2.0)	Increase	
3 pathology tests ordered (95% CI)	1.1 (1.0–1.2)	1.3 (1.2–1.4)	1.4 (1.3–1.5)	Increase	
4 pathology tests ordered (95% CI)	0.6 (0.6–0.7)	0.7 (0.6–0.8)	0.9 (0.8–1.0)	Increase	
5 pathology tests ordered (95% CI)	0.4 (0.4–0.5)	0.6 (0.5–0.6)	0.8 (0.7–0.9)	Increase	
Mean number of pathology tests per 100 problems for which pathology ordered (95% CI)	173 (169–176)	178 (174–182)	197 (193–200)	Increase	

(a) Regression coefficient expresses the mean annual change in ordering rates.

Note: CI—confidence interval; shading indicates significant differences between study years.

3.2 Changes in pathology ordering rates over time excluding Pap smears

A Pap smear is a screening procedure which is encouraged to be undertaken on a regular basis, both through public education and general practitioner education. An increase in GP ordering rates for Pap smears would therefore be regarded as a positive outcome, for it should be a reflection of increased coverage rates in the female community. Further, Britt, Miller et al. (1999) demonstrated that female GPs order far more Pap smears than their male counterparts.[1] Since one of the subjects of interest in the current study was the relationship between GP sex and pathology ordering, and because of the likely influences of education initiatives on Pap smear test patterns, all Pap smears have been excluded from the analysis presented in this report (apart from the analysis in Section 3.1).

Where an encounter included an order for only one pathology test, and that test was a Pap smear, the encounter was regarded as a 'non-pathology encounter'. Where the encounter included a Pap smear plus at least one other order for a pathology test, it was classified as a 'pathology encounter'.

Where a problem was associated with only one pathology test, and that test was a Pap smear, the problem was regarded as a 'non-tested problem'. Where the problem was associated with a Pap smear plus at least one other order for a pathology test, it was classified as a 'tested problem'.

Thus, for the purposes of comparisons between characteristics of pathology and non-pathology encounters, 'Pap smear only' encounters are classified as non-pathology encounters and 'Pap smear only' problems are regarded as non-tested problems.

The remainder of this report is based on total pathology tests ordered excluding Pap smears. Therefore the earlier analysis (for total pathology) has been repeated and Table 3.2 provides the same set of results for changes in rates of pathology test orders after the Pap smears were removed.

Overview of ordering rates

Between 1998–99 and 2000–01 the rate of pathology tests ordered (without Pap smears) per 100 encounters increased from 23.1 per 100 to 28.0 per 100 ($p<0.0001$), an increase of 4.9 tests per 100 encounters, or 21.2% (Table 3.2).

To test the extent to which this increase simply reflected an increase in the number of problems managed by GPs, the rate of pathology tests ordered per 100 problems managed was examined. This rate also proved to have increased significantly, from 16.3 per 100 problems managed to 19.9 per 100 ($p<0.0001$), an increase of 3.6 test orders per 100 problems, or 22.1%.

While there was no significant increase in the likelihood of the GP ordering any pathology at an encounter when all pathology tests were considered, after exclusion of Pap smears there was a small but significant increase in the likelihood of the GP ordering some pathology for a specific problem. That is, there was a slight increase in the proportion of problems for which at least one pathology test was ordered, from 9.1% (95% CI: 8.8–9.4) in 1998–99 to 9.7% (95% CI: 9.4–10.0) in 2000–01 ($p=0.006$).

Rates of pathology tests orders per encounter

Investigation of the distribution of pathology test orders across encounters demonstrated that the proportion of encounters for which at least one pathology test was ordered by the GP remained constant over the study period at about 12–13%. That is, there was no increase in the likelihood of the GP ordering pathology at an encounter over the study period.

However, at encounters that did generate pathology test orders significant changes were apparent in the pattern of ordering.

- The proportion of encounters at which a single pathology test was ordered decreased significantly over the three years, from 6.7% (95% CI: 6.4–7.0) to 5.8% (95% CI: 5.5–6.1).
- There was no change in the proportion of encounters at which two pathology tests were ordered, remaining constant at 2.1%–2.4%.
- There was a significant increase in the proportion of encounters at which three, four and five tests were ordered, the changes being:
  - an increase in the proportion of encounters at which three tests were ordered, from 1.6% (95% CI: 1.4–1.7) in 1998–99 to 1.9% (95% CI: 1.8–2.0) in 2000–01
  - an increase in the proportion of encounters at which four tests were ordered, from 1.0% (95% CI: 0.9–1.0) in 1998–99 to 1.3% (95% CI: 1.2–1.4) in 2000–01
  - an increase in the proportion of encounters at which five tests were ordered, from 0.8% (95% CI: 0.7–0.8) in 1998–99 to 1.3% (95% CI: 1.2–1.4).

These changes resulted in an increase in the mean number of pathology tests ordered at those encounters that generated an order, from 192 per 100 problems involving pathology tests in 1998–99 to 221 per 100 in 2000–01, an average annual increase of 14.5 tests per 100 tested encounters ($p<0.0001$).

Rates of pathology test orders per problem

Investigation of the distribution of pathology test orders across individual problem management demonstrated there had been a small but significant increase in the proportion of problems for which at least one pathology test was ordered over this period, from 9.1% (95% CI: 8.8–9.4) of problems managed in 1998–99 to 9.7% (95% CI: 9.4–10.0).

Further, for those problems for which the GP did decide to order pathology, significant changes in the number of test ordered for the problem under management were apparent.

- The proportion of problems generating a single pathology test decreased significantly over the three years from 5.4% (95% CI: 5.2–5.6) to 4.9% (95% CI: 4.7–5.1).
- There was a significant increase in the proportion of problems for which two pathology tests were ordered, from 1.6% (95% CI: 1.5–1.7) in 1998–99 to 1.9% (95% CI: 1.8–2.0) in 2000–01.
- There was a significant increase in the proportion of problems for which three tests were ordered, from 1.1% (95% CI: 1.0–1.1) in 1998–99 to 1.4% (95% CI: 1.3–1.5) in 2000–01.
- There was a significant increase in the proportion for which four tests were ordered, from 0.6% (95% CI: 0.6–0.7) in 1998–99 to 0.9% (95% CI: 0.8–0.9).
- There was a significant increase in the proportion for which five tests were ordered, from 0.4% (95% CI: 0.4–0.5) in 1998–99 to 0.8% (95% CI: 0.7–0.8).

Table 3.2: Pathology ordering rates over time excluding orders for Pap smears (annual weighted data)

Pathology test ordering measure	1998–99	1999–00	2000–01	Trend coefficient [(a)]	p–value
Pathology test rate per 100 encounters (95% CI)	23.1 (22.1–24.2)	24.9 (23.7–26.0)	28.0 (26.8–29.2)	2.4	<0.0001
Pathology test rate per 100 problems (95% CI)	16.3 (15.6–17.0)	17.4 (16.7–18.1)	19.9 (19.1–20.7)	1.8	<0.0001
At least one pathology test per encounter Per cent of encounters (95% CI)	12.0 (11.6–12.5)	12.6 (12.1–13.1)	12.7 (12.2–13.1)	0.3	0.046
At least one pathology test per problem Per cent of problems (95% CI)	9.1 (8.8–9.4)	9.5 (9.1–9.8)	9.7 (9.4–10.0)	0.3	0.006
Number of pathology tests per encounter Per cent of encounters (95% CI)	**1998–99**	**1999–00**	**2000–01**	**Direction of change**	
No pathology tests ordered (95% CI)	88.0 (87.5–88.4)	87.4 (86.9–87.9)	87.3 (86.9–87.8)	No change	
1 pathology test ordered (95% CI)	6.7 (6.4–7.0)	6.9 (6.5–7.2)	5.8 (5.5–6.1)	Decrease	
2 pathology tests ordered (95% CI)	2.1 (2.0–2.3)	2.1 (2.0–2.2)	2.4 (2.2–2.5)	No change	
3 pathology tests ordered (95% CI)	1.6 (1.4–1.7)	1.7 (1.6–1.8)	1.9 (1.8–2.0)	Increase	
4 pathology tests ordered (95% CI)	1.0 (0.9–1.0)	1.0 (1.0–1.1)	1.3 (1.2–1.4)	Increase	
5 pathology tests ordered (95% CI)	0.8 (0.7–0.8)	0.9 (0.8–1.0)	1.3 (1.2–1.4)	Increase	
Mean number of pathology tests per 100 encounters at which pathology ordered (95% CI)	192 (188–196)	197 (193–202)	221 (216–225)	Increase	
Number of pathology tests per problem Per cent of problems managed	**1998–99**	**1999–00**	**2000–01**	**Direction of change**	
No pathology tests ordered (95% CI)	90.9 (90.6–91.2)	90.5 (90.2–90.9)	90.3 (90.0–90.6)	No change	
1 pathology test ordered (95% CI)	5.4 (5.2–5.6)	5.5 (5.3–5.8)	4.9 (4.7–5.1)	Decrease	
2 pathology tests ordered (95% CI)	1.6 (1.5–1.7)	1.6 (1.5–1.7)	1.9 (1.8–2.0)	Increase	
3 pathology tests ordered (95% CI)	1.1 (1.0–1.1)	1.2 (1.1–1.3)	1.4 (1.3–1.5)	Increase	
4 pathology tests ordered (95% CI)	0.6 (0.6–0.7)	0.7 (0.6–0.7)	0.9 (0.8–0.9)	Increase	
5 pathology tests ordered (95% CI)	0.4 (0.4–0.5)	0.5 (0.5–0.6)	0.8 (0.7–0.8)	Increase	
Mean number of pathology tests per 100 problems for which pathology ordered (95% CI)	180 (176–184)	184 (180–188)	205 (201–208)	Increase	

(a) Regression coefficient expresses the mean annual change in ordering rates.

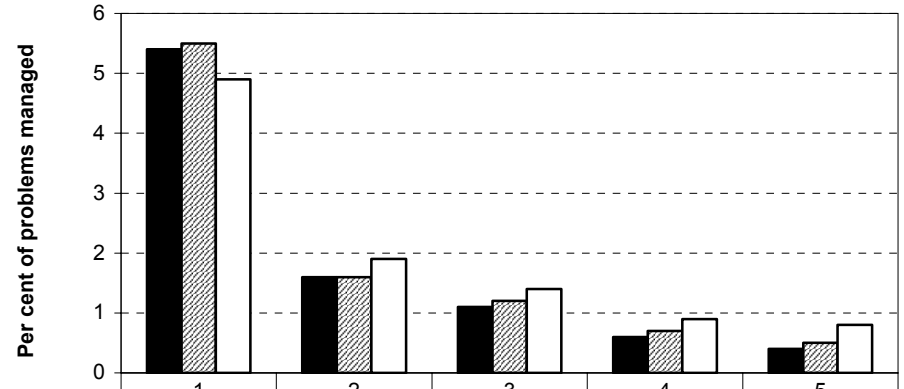
Note: CI—confidence interval; shading indicates significant differences between study years.

The increase in the proportion of problems generating at least one pathology order was about 6.5% over the study period. The changes in the number of tests ordered per problem were more considerable. These results are graphically presented in Figure 3.1.

There was:

- almost a 10% decrease in rate of ordering only one pathology test
- a 19% increase in the proportion of problems generating two test orders
- a 27% increase in the proportion generating three test orders
- a 50% increase in the proportion generating four tests
- a 100% increase in the proportion generating five tests.

These changes also resulted in an increase in the mean number of pathology test orders per 100 tested problems, from 180 per 100 in 1998–99 to 205 per 100 in 2000–01, resulting in an extra 12.5 tests per 100 tested problems per year ($p<0.0001$).



	1	2	3	4	5
1998–99	5.4	1.6	1.1	0.6	0.4
1999–00	5.5	1.6	1.2	0.7	0.5
2000–01	4.9	1.9	1.4	0.9	0.8

Figure 3.1 : Per cent of problems for which pathology tests were ordered by number of tests ordered

Changes in the patterns of tests ordered by MBS pathology item groups

Chemical pathology: When the pathology tests ordered were considered in terms of the MBS pathology groups most common in general practice, it was apparent that the major increase in order rates was in the area of Chemical pathology. In 1998–99 GPs ordered tests in this group at a rate of 11.3 per 100 encounters but this significantly increased in 2000–01 to 15.4 per 100 (an increase of 36.3%; $p<0.0001$).

Tests classed as **Haematology** also increased significantly but not to the same extent as those in Chemical pathology, from 5.1 per 100 encounters in 1998–99 to 5.7 per 100 in 2000–01, an increase of 11.7% ($p=0.0093$).

Histopathology: Though the low rate of orders for Histopathology suggested no change over time, multiple regression analysis suggested that there had been a significant but marginal increase in order rates for these tests (p=0.0160).

Infertility: Tests classed in the MBS group Infertility were ordered at a rate in 2000–01 that was 0.1 test per 100 encounters less than that in 1998–99, and this decrease was statistically significant (p<0.0001).

There were no other MBS pathology groups for which relative order rates from GPs changed significantly over the period of the study (Table 3.3).

Table 3.3: Relative rate of orders per 100 encounters for pathology tests (excluding Pap smears) in major MBS groups, by year

	Tests per 100 encounters (95% CI)		
Pathology test ordered	**1998–99**	**1999–00**	**2000–01**
Chemical pathology	11.3 (10.6–11.9)	12.1 (11.4–12.8)	15.4 (14.6–16.2)
Haematology	5.1 (4.8–5.3)	5.1 (4.8–5.4)	5.7 (5.4–6.0)
Microbiology	4.1 (3.8–4.3)	4.6 (4.3–4.9)	4.5 (4.2–4.7)
Infertility/pregnancy	0.4 (0.4–0.5)	0.4 (0.3–0.5)	0.3 (0.2–0.3)
Histopathology	0.4 (0.4–0.5)	0.5 (0.4–0.6)	0.4 (0.4–0.5)
Immunology	0.4 (0.3–0.5)	0.5 (0.4–0.6)	0.5 (0.5–0.6)

Note: CI—confidence interval; shading indicates significant differences between study years.

Changes in the relative frequency of orders for selected test types over time

Table 3.4 provides the relative order rates for selected common tests for each year of the study period. These sixteen test types accounted for approximately 75% of all pathology tests ordered in each year. The significant changes in the relative rate of orders for specific test types included:

- an increase in orders for full blood count, from 3.5 in 1998–99 to 3.8 per 100 encounters in 2000–01
- an increase in lipid test orders from 2.3 to 3.3 per 100 encounters over this period
- significant fluctuations in the order rate of liver function tests. These decreased in relative frequency between from 2.0 per 100 encounters in 1998–99, to 1.5 per 100 in 2000–01 but then reverted to their previous level of 2.0 per 100 in 2000–01
- an increase in the rate of electrolytes, urea and creatinine (EUC) tests from 1.5 in 1998–99 to 1.9 per 100 encounters in 2000–01
- an increase in glucose tests for 1.4 per 100 encounter in both 1998–99 and 1999–00 to 2.1 per 100 in 2000–01
- a marginal increase in Ferritin tests from 0.4 per 100 encounters to 0.6 per 100.

However, the too largest increases in relative test rates were for:

- multibiochemical analysis, the rate of which increased threefold from 0.4 per 100 encounters in 1998–99 to 1.1 per 100 encounters in 1999–00, and this rate of ordering remained steady (at 1.2) during 2000–01
- hormone assays which increased from a relative rate of 0.3 per 100 encounters in 1998–99 to 0.6 per 100 the following year and finally to 0.8 per 100 encounters in 2000–01.

There were no significant changes in the relative order rates of the remaining common tests, such as ESRs, urine microscopy, culture and sensitivity (MC&S) and hepatitis serology.

There was one test which showed a decrease in relative frequency over the three years of the study and that was the infertility/pregnancy group, decreasing from 0.5 per 100 encounters in 1998–99 to 0.3 per 100 in 2000–01.

Table 3.4: Relative rate of orders for most frequent pathology tests (excluding Pap smears) per 100 encounters, by year (weighted data)

	Tests per 100 encounters (95% CI)		
Pathology test ordered	**1998–99**	**1999–00**	**2000–01**
Full blood count	3.5 (3.4–3.7)	3.4 (3.2–3.5)	3.8 (3.7–4.0)
Lipids	2.3 (2.2–2.5)	2.3 (2.2–2.5)	3.3 (3.1–3.5)
Liver function	2.0 (1.8–2.1)	1.5 (1.4–1.7)	2.0 (1.8–2.1)
EUC	1.5 (1.4–1.6)	1.6 (1.4–1.7)	1.9 (1.7–2.0)
Urine MC&S	1.5 (1.4–1.6)	1.6 (1.5–1.7)	1.5 (1.4–1.6)
Glucose—all	1.4 (1.3–1.5)	1.4 (1.3–1.5)	2.1 (1.9–2.2)
Thyroid function	1.2 (1.1–1.3)	1.2 (1.1–1.3)	1.3 (1.2–1.4)
ESR	0.7 (0.6–0.8)	0.8 (0.7–0.9)	0.9 (0.8–0.9)
Coagulation	0.7 (0.6–0.7)	0.7 (0.6–0.8)	0.8 (0.7–0.9)
Hepatitis serology	0.5 (0.5–0.6)	0.5 (0.5–0.6)	0.6 (0.5–0.6)
Infertility/pregnancy	0.5 (0.4–0.5)	0.4 (0.3–0.5)	0.3 (0.2–0.3)
Ferritin	0.4 (0.4–0.5)	0.5 (0.5–0.6)	0.6 (0.5–0.6)
HbA1c	0.4 (0.4–0.5)	0.5 (0.4–0.5)	0.6 (0.5–0.7)
Multibiochemical analysis	0.4 (0.3–0.5)	1.1 (1.0–1.3)	1.2 (1.0–1.3)
Prostate specific antigen	0.4 (0.3–0.4)	0.4 (0.3–0.4)	0.5 (0.4–0.5)
Hormone assay	0.3 (0.3–0.4)	0.6 (0.5–0.6)	0.8 (0.7–0.9)
HIV	0.2 (0.2–0.3)	0.3 (0.2–0.3)	0.3 (0.2-0.3)
Subtotal these tests (% of all pathology)	*77.3*	*75.1*	*79.5*

Note: CI—confidence interval; shading indicates significant differences between study years.

4 Changes over time in the characteristics of GPs

It was hypothesised that any changes in pathology ordering rates may merely reflect a change in the characteristics of the GPs participating in the BEACH program between 1998–99 and 2000–01. This chapter investigates the extent to which the GP characteristics changed over this period and the extent to which any changes found in the BEACH GP samples over time reflected a true change in the characteristics of the total practising GP population in the sample frame each year.

Table 4.1 presents the characteristics of the GPs who participated in BEACH in each of the three years under investigation.

4.1 Changes in the characteristics of BEACH participants over time

Significant changes were apparent in some of the characteristics of the participating GPs over the three years of interest.

- There was a significant ageing of the participating sample. In 1998–99, 28.6% of the sample were aged less than 35 years and 30.0% were 55 years or older, while in 2000–01 30.9% of participants were less than 35 years old and 36.1% were over 54 years old ($p=0.007$).
- The size of practice varied across the years but there was a significant trend for an increase in the proportion of GPs who were in solo practice and in practices of five or more GPs, and a decrease in the proportion who were in practices of 2–4 GPs ($p=0.0034$).
- There was a significant increase in the proportion of participants who had graduated overseas, from 23.5% in 1998–99 to 26.8% in 2000–01 ($p<0.0001$), and this was reflected in a significant increase in the proportion who stated they conducted more than 50% of their consultations in a language other than English (from 11.4% to 13.6%) ($p=0.04$).
- The state distributions of participants were significantly different over the three years of the study but there was no clear trend in the movements across states over the study period.

There were no significant changes between 1998–99 and 2000–01 in:

- the proportion of GP participants who were male
- the number of sessions worked per week in clinical general practice
- the distribution of participating GPs across the categories of Rural, Remote and Metropolitan Areas[22]
- the proportion of participants who were Fellows of the RACGP.

4.2 Changes in the characteristics of GPs in the national sample frame over time

The important question for the current study is whether or not the changes in the characteristics of BEACH participants reflect true changes in the characteristics of the total practicing GP population between 1998–99 and 2000–01, or whether this is merely sampling error in BEACH.

As explained earlier (Chapter 2 Methods), at the end of each BEACH data year the characteristics of the participating GPs are compared with those characteristics available from the HIC for the total sample frame (Australian population of active GPs). Where differences are found between the final participating sample in that year and the total sample frame, post-stratification weighting is applied to correct for these differences. Theoretically, therefore, the characteristics of the sample of GPs after weighting should reflect those of the total GP population (sampling frame) in each year.

The age–sex distribution of the GP population is directly measured in the sampling frame. Other characteristics such as place of graduation and size of practice are not directly measured and therefore need to be estimated from the BEACH sample. The GP weights have been calculated to directly standardise the BEACH GP sample to the GP population of that year. Then by definition, the weighted age–sex distribution of the BEACH GP sample is the same as the age–sex profile of the GP population. It follows that by comparing the weighted age–sex distribution of each year's sample we can indirectly assess whether there has been any significant changes over time in the age–sex distribution of Australian GPs. Changes in the weighted age–sex distribution therefore provides a reference for understanding whether any changes in the age–sex distribution of the BEACH sample (unweighted) reflects true changes in the population profile or arises simply as a result of random sampling error.

The three right-hand columns in Table 4.1 provide the estimates of GP characteristics after weighting has been applied. Data are provided for each of the three years after each year has been individually weighted (see Chapter 2 Methods). These results can be regarded as the best estimates for the GP population for characteristics that have not been directly measured.

Results

Changes in the characteristics of the GPs in the final sample that remained after adjustment, suggesting a real change in these characteristics in the total active GP population, were:

- a significant increase in the proportion of GPs who had graduated outside Australia ($p<0.0001$)
- a statistically significant change in the distribution of GPs across states and territories over the three years ($p=0.017$) but no clear pattern of change was apparent.

There was no significant change apparent in the age distribution of the GPs in the sample frame. The sex distribution of GPs in the total sample frame did not differ over time. A significant increase in the proportion of GPs who reported consulting more than half the time in a language other than English and the change in practice size, noted in the GP participants, became marginal after post-stratification weighting ($p=0.05$ and $p=0.07$) suggesting it is unlikely that a change has occurred in these factors in the total practising GP population.

Table 4.1: Characteristics of GPs participating in BEACH and of GPs in the weighted GP sample, by year

	Unweighted raw figures						The final sample after weighting (representing the national sample frame)		
	1998–99 (*n*=984)		1999–00 (*n*=1,047)		2000–01 (*n*=999)		1998–99	1999–00	2000–01
GP characteristic	*n*	Per cent[(a)]	*n*	Per cent[(a)]	*n*	Per cent[(a)]	Per cent	Per cent	Per cent
Sex	**(χ^2=0.698, p=0.705)**						**(χ^2=1.06, p=0.059)**		
Male	689	70.0	729	69.6	683	68.4	68.1	70.1	68.4
Female	295	30.0	318	30.4	316	31.6	31.9	28.8	31.7
Age	**(χ^2=17.74, p=0.007)**						**(χ^2=12.49, p=0.052)**		
(Missing)	(4)	—	(4)	—	(9)	—	—	—	—
<35 years	62	28.6	88	40.6	67	30.9	15.7	11.4	12.4
35–44 years	356	36.4	338	34.6	284	29.0	33.7	32.0	31.5
45–54 years	315	31.7	338	34.0	342	34.4	28.8	32.6	32.2
55+ years	247	30.0	279	33.9	297	36.1	21.8	24.0	24.0
Sessions per week	**(χ^2=7.39, p=0.12)**						**(χ^2=6.57, p=0.16)**		
(Missing)	(12)	—	(6)	—	(17)	—	—	—	—
<6 per week	120	12.3	159	15.3	159	15.9	12.0	14.8	15.5
6–10 per week	666	68.5	691	66.0	662	66.3	69.8	67.1	68.4
11+ per week	186	19.1	191	18.3	162	16.2	18.2	18.2	16.2
Size of practice	**(χ^2=15.72, p=0.0034)**						**(χ^2=8.56, p=0.07)**		
(Missing)	(14)	—	(5)	—	(28)	—	—	—	—
Solo	167	17.2	187	18.0	187	19.3	15.8	17.3	18.0
2–4 GPs	433	44.6	383	36.8	375	38.6	42.5	36.5	39.1
5+ GPs	370	38.1	472	45.3	409	42.1	41.7	46.2	43.0
Place of graduation	**(χ^2=149.93, p<0.0001)**						**(χ^2=141.37, p<0.0001)**		
(Missing)	(4)	—	(13)	—	(7)	—	—	—	—
Australia	750	76.5	763	73.8	726	73.2	78.3	74.8	75.0
Other	230	23.5	271	26.2	266	26.8	21.7	25.2	25.0
State/Territory	**(χ^2=25.58 p<0.029)**						**(χ^2=27.45, p=0.017)**		
(Missing)	(0)	—	(2)	—	(0)	—	—	—	—
New South Wales	362	36.8	391	37.4	386	38.6	36.3	36.9	38.1
Victoria	236	24.0	210	20.1	239	23.9	23.9	20.5	24.0
Queensland	185	18.8	211	20.2	145	14.5	19.3	20.2	14.6
South Australia	75	7.6	95	9.1	78	7.8	8.1	9.0	7.9
Western Australia	73	7.4	92	8.8	88	8.8	7.0	8.9	9.0
Tasmania	22	2.2	25	2.4	33	3.3	2.2	2.5	3.4
ACT	18	1.8	12	1.2	22	2.2	1.8	1.1	2.1
Northern Territory	13	1.3	9	0.9	8	0.8	1.5	0.8	0.8

(continued)

Table 4.1 (continued): Characteristics of GPs participating in BEACH and of GPs in the weighted GP sample, by year

	Unweighted raw figures						The final sample after weighting (representing the national sample frame)		
	1998–99 (*n*=984)		1999–00 (*n*=1,047)		2000–01 (*n*=999)		1998–99	1999–00	2000–01
GP characteristic	***n***	**Per cent[(a)]**	***n***	**Per cent[(a)]**	***n***	**Per cent[(a)]**	**Per cent**	**Per cent**	**Per cent**
Practice location	**(χ^2=10.979, p=0.53)**						**(χ^2=9.47, p=0.66)**		
(Missing)	(0)	—	(0)	—	(0)	—	—	—	—
Capital	671	68.2	683	65.2	680	68.1	68.1	65.3	67.5
Other Metropolitan	74	7.5	77	7.4	69	6.9	7.1	7.3	7.0
Large Rural	61	6.2	80	7.6	55	5.5	6.2	7.6	5.6
Small Rural	60	6.1	65	6.2	56	5.6	6.0	6.2	5.9
Other Rural	108	11.0	128	12.2	122	12.2	11.5	12.4	12.3
Remote Central	5	0.5	4	0.4	10	1.0	0.6	0.4	1.0
Other Remote, Offshore	5	0.5	10	1.0	7	0.7	0.5	1.0	0.9
Fellow of RACGP	**(χ^2=5.39, p=0.06)**						**(χ^2=1.94, p=0.38)**		
	263	27.3	325	31.3	314	31.5	32.3	33.6	35.3
>50% consultations other than English	**(χ^2=6.21, p=0.04)**						**(χ^2=5.86, p=0.05)**		
	111	11.4	105	10.1	135	13.6	11.2	9.8	13.2

(a) Missing data removed.

Note: *n*—number; ACT—Australian Capital Territory.

5 GP characteristics and pathology ordering rates

This chapter investigates the interrelationship of pathology ordering rates and selected characteristics of the GP population. The research question is, does the age and/or sex of the GP influence rates of pathology test ordering?

This analysis used all data from the three samples as one data set and compared the relative rates of pathology ordering for different groups of GPs.

5.1 Pathology test rates over all encounters and all problems

The first four columns of results in Table 5.1 provide comparative results for a range of GP characteristics, of pathology-ordering behaviour in terms of:

- the proportion of encounters generating at least one pathology order
- the number of tests ordered per 100 total encounters
- the percentage of problems for which at least one pathology test was ordered and
- the number of tests per 100 problems.

Significant relationships between all these measures were investigated with GP sex, GP age group, size of practice, urban/rural practice location and state/territory of practice.

GP sex

When compared with male GPs, female GPs were significantly more likely to order pathology at the encounter (15.3% compared with 12.0% for male GPs) and significantly more likely to order at least one test for a problem managed (11.0% compared with 9.1%). This resulted in significantly higher test ordering rates per 100 encounters (32.2 tests per 100 encounters) and per 100 problems (21.2) than for their male counterparts (24.4 and 17.3 per 100 respectively). Note that the differences in these rates were quite large even though Pap smears were excluded from the analysis. At encounters that resulted in one or more pathology test orders there was no difference in the number of tests ordered per 100 encounters between the sexes (both ordering 200 tests per 100 encounters at which pathology was ordered). The influence of patient characteristics on these results is investigated later in this report.

GP age

There was not a clear linear relationship between age group and ordering rates. The highest pathology ordering rate was generated by the second youngest group of GPs, those aged between 35 and 44 years, who ordered an average 30.4 tests per 100 encounters. This rate decreased significantly in a stepwise manner in both of the older age groups, to 26.6 per 100 encounters for those of 45–54 years and again to 22.0 per 100 encounters in GPs aged 55 years or more. If there were a straight linear relationship between age and ordering rates, the youngest age group should have an even higher ordering rate than those of 35–44 years.

This was not the case. GPs aged less than 35 years ordered significantly more tests than those 45 years and older but about the same number as those of 35–44 years.

Size of practice

There was a significant linear relationship between size of practice and pathology test ordering rates—the larger the practice the higher the rate, relative to both the number of encounters and the number of problems managed. Solo GPs had the lowest ordering rate at 22.5 tests per 100 encounters (95% CI: 21.1–23.9) and those in larger group practices of 5 or more GPs, the highest rate of 28.8 tests per 100 encounters (95% CI: 27.7–29.8).

State/territory of practice

There were no significant differences in any of the pathology ordering rates between GPs practising in different states.

Urban/rural location

GPs practising in rural and remote areas were more likely to order at least one pathology test per encounter (14.7%) and per problem (10.8% of problems) than their urban counterparts (12.5% of encounters and 9.4% of problems). They also had a significantly higher pathology ordering rate (29.9 tests ordered per 100 encounters, 95% CI: 28.6–31.2) than those working in urban areas (25.7 per 100, 95% CI: 25.0–26.5). Rates per 100 problems managed were also significantly different for these two groups of GPs, rural GPs ordering 20.5 tests per 100 problems managed compared with 17.9 per 100 for urban GPs.

5.2 Pathology test ordering rates after the decision to order pathology

The two right-hand columns of Table 5.1 provide comparative results for the number of tests ordered per 100 encounters and per 100 problems where at least one test was ordered. This provides a measure of the multiple nature of ordering after the decision to order pathology is made.

GP age

The age group of the GP was the only GP characteristic that showed a relationship between the number of tests ordered after deciding to order. There was a steady and significant inverse linear relationship between the age group of the GP and the average number of tests ordered once deciding to place a pathology test order—the younger the doctor, the more tests were ordered on average. When they decided to order pathology, the GPs aged less than 35 years ordered significantly more tests (222) per 100 encounters and more per 100 problems (206) than any other age group. The rate steadily decreased with GP age group to be 192 per 100 encounters and 180 per 100 problems managed for GPs of 55 years or more.

Other characteristics

There was no significant relationship between the number of tests ordered per 100 pathology encounters or in the number of tests ordered per 100 tested problems, and GP sex, size of practice, state/territory or rurality of practice.

Table 5.1: Pathology ordering rates (excluding Pap smears) by GP sex and GP age

GP characteristic	Per cent of encounters at least one pathology (95% CI)	Number of tests per 100 encs (95% CI)	Per cent of problems at least one pathology (95% CI)	Number of tests per 100 problems (95% CI)	Pathology tests per 100 encs where pathology ordered (95% CI)	Pathology tests per 100 problems where pathology ordered (95% CI)
Sex						
Male	12.0 (11.7–12.3)	24.4 (23.6–25.2)	9.1 (8.9–9.4)	17.3 (16.8–17.9)	203 (200–207)	190 (187–193)
Female	15.3 (14.9–15.8)	32.2 (31.0–33.3)	11.0 (10.7–11.4)	21.2 (20.5–22.0)	210 (206–214)	192 (189–196)
Age group						
<35 years	13.3 (12.5–14.1)	29.5 (27.5–31.6)	10.4 (9.9–11.0)	21.4 (20.1–22.8)	222 (215–230)	206 (199–213)
35–44 years	14.4 (13.9–14.9)	30.4 (29.1–31.6)	10.7 (10.4–11.0)	20.8 (20.0–21.6)	211 (207–215)	194 (191–198)
45–54 years	12.9 (12.5–13.3)	26.6 (25.5–27.7)	9.6 (9.3–9.9)	18.4 (17.7–19.2)	207 (203–211)	191 (188–194)
55+ years	11.5 (11.0–12.0)	22.0 (20.8–23.2)	8.5 (8.2–8.9)	15.4 (14.6–16.2)	192 (187–197)	180 (176–184)
Size of practice						
Solo GP	11.3 (10.6–11.9)	22.5 (21.1–23.9)	8.4 (7.9–8.8)	15.5 (14.6–16.5)	200 (194–206)	186 (180–192)
2–4 GPs	13.1 (12.7–13.5)	26.9 (25.9–28.0)	9.8 (9.5–10.0)	18.5 (17.8–19.2)	205 (201–209)	189 (186–193)
5+ GPs	13.8 (13.4–14.2)	28.8 (27.7–29.8)	10.4 (10.1–10.7)	20.2 (19.5–20.9)	209 (205–212)	194 (190–197)
State						
New South Wales	12.8 (12.4–13.2)	26.1 (25.1–27.2)	9.5 (9.2–9.8)	18.0 (17.3–18.7)	204 (200–208)	189 (186–193)
Victoria	12.7 (12.2–13.2)	26.9 (25.4–28.3)	9.5 (9.1–9.9)	18.5 (17.6–19.5)	212 (206–217)	195 (190–200)
Queensland	13.7 (13.1–14.4)	28.4 (26.4–30.1)	10.3 (9.8–10.8)	20.0 (18.8–21.1)	206 (201–212)	194 (189–198)
South Australia	12.8 (11.9–13.6)	24.9 (22.8–27.0)	9.7 (9.1–10.3)	17.6 (16.2–18.9)	195 (188–202)	181 (175–187)
Western Australia	13.8 13.0–14.6)	29.4 (27.1–31.6)	10.3 (9.7–10.9)	20.1 (18.7–21.6)	213 (205–221)	195 (187–202)
Tasmania	12.7 (11.4–13.9)	23.9 (21.2–26.6)	9.4 (8.5–10.3)	16.5 (14.8–18.4)	189 (178–198)	176 (167–185)
ACT	11.3 (9.8–12.9	22.9 (19.2–26.6)	9.0 (7.9–10.1)	16.7 (14.4–19.0)	202 (187–217	186 (173–199)
Northern Territory	15.2 (12.5–17.9)	31.3 (23.9–38.7)	11.7 (9.9–13.5)	22.0 (17.5–26.6)	206 (181–230)	188 (167–210)
Rurality						
Rural/remote	14.7 (14.2–15.2)	29.9 (28.6–31.2)	10.8 (10.4–11.2)	20.5 (19.6–21.3)	204 (200–208)	190 (186–193)
Urban	12.5 (12.2–12.7)	25.7 (25.0–26.5)	9.4 (9.2–9.6)	17.9 (17.4–18.4)	207 (204–210)	191 (189–194)

Note: encs—encounters; CI—confidence interval; ACT—Australian Capital Territory; shading indicates significant differences between groups.

5.3 Summary of findings

There is a strong relationship between pathology ordering rates and GP age, GP sex, the geographic location (urban/rural) of their practice and its size. Female GPs, those of 45–54 years of age, those practising in rural/remote areas and those in larger practices have significantly higher rates of pathology test orders than their counterparts. There is also a significant inverse relationship between age and the number of tests ordered after a decision to order pathology, such that younger GPs order more tests per tested problem than older GPs.

5.4 Do any changes in GP age and sex over time explain the increase in pathology test orders over the same period?

It was hypothesised that if the age and gender distribution of the GPs had changed over time and that if these was a relationship between pathology ordering rates and GP age and/or GP sex, this relationship may explain any measured increase in pathology test ordering rates between 1998–99 and 2000–01.

Chapter 3 demonstrated a significant increase in pathology test ordering rates over the period of the study. Chapter 4 demonstrated no significant changes over the study period in the age and sex distribution of the final weighted GP sample, and therefore of the total practising GP population.

However, multiple regression was used to further test the relationship between GP age, sex and time since marginal changes over time may still impact on pathology ordering rates.

GP age and sex were significantly related to pathology ordering and were a potential confounder of any observed changes in pathology rates over time. Therefore multiple regression, adjusting for GP age and sex, was performed, to test whether the observed increase in pathology over time was in fact explained by differences in GP demographics observed in the three (unweighted) samples.

The results demonstrated that the higher rates of pathology orders among female GPs was found across all age groups and in each of the three years of the study (GP sex, adjusted for age and time; $p<0.0001$). The relationship of decreased pathology ordering with increasing GP age was also demonstrated to be true for all three years of the study and for both sexes (GP age, adjusted for GP sex and time; $p<0.0001$). However, it was also found that after controlling for GP age and sex there remained an increase in pathology ordering over time that was not accounted for by GP age and sex (time, adjusted for GP age and sex; $p<0.0001$).

6 The purpose for which pathology tests are ordered

This chapter investigates the extent to which there have been any changes in the purposes for which GPs are ordering pathology. A subject of specific interest in the earlier study of pathology ordering by GPs was the extent to which GPs were ordering pathology for diagnostic purposes versus monitoring purposes. In that study a method was devised for allocating each pathology test to a class through its relationship with the type of problem for which the test was ordered.[1]

The structure of the ICPC-2 (see Chapter 2 Methods) was used to develop a definition of problems likely to have tests ordered for monitoring purposes and those likely to have tests ordered for diagnostic purposes. The first option was to regard:

- all pathology ordered for problems in Component 1 (Symptoms and complaints) as investigative/diagnostic in nature
- all pathology ordered for problems in Component 7 (Diagnosis/disease) as being for monitoring purposes
- all pathology ordered for problems in Components 2–6 (process codes) as 'undecided'.

This breakdown assumed that where a GP uses a disease label (rather than a symptom label) the diagnosis has already been confirmed through prior investigation. However, this assumption may not hold because the diagnostic component includes five subgroups

- infections
- neoplasms
- injuries
- congenital anomalies
- other diagnosis/disease

The infections section of this component includes a large number of terms that are used by GPs to describe a problem before there is pathological evidence for the diagnosis. They rely on clinical experience to determine the diagnosis and may then send the patient for pathological confirmation. With these issues in mind, an investigation of the ICPC rubrics, chapters and components led to the following breakdown:

- Problems likely to generate pathology tests ordered for investigative/diagnostic purposes (*diagnostic pathology)* included all of Component 1 (Symptoms and complaints), all infections (from Component 7) and all misadventure codes.
- Problems likely to be related to pathology orders for disease-monitoring purposes (*monitoring pathology*) included all ICPC codes from Component 7 except for the infection codes and the misadventure codes.
- Full check-ups and partial check-ups in each chapter of ICPC were not seen as fitting with either the *diagnostic pathology'* group or the disease *monitoring* group. A separate class was therefore established, including all check-ups, whether partial or full. This class will be referred to as *preventive care pathology*.

- Problem labels which described service provisions (including specified pathology tests, advice and health education, medication renewals, referrals and other services) were seen as possibly fitting into any of the above three groups depending on the circumstances on each occasion. These were therefore grouped in an additional class called *other pathology*.

Using the above definitions the problems managed in the total data set were allocated to a class. This analysis considers each test order in relation to each problem for which it was ordered. Thus a test ordered for more than one problem is counted more than once. It is the problem–pathology test combination which is the unit of analysis.

6.1 Distribution and rates of pathology tests by class

Table 6.1 provides the comparative class distribution of all pathology test–problem combinations in each of the three years included in this study. There was very little change in the distribution of pathology tests by purpose. That is, irrespective of the increase in overall pathology test orders already identified (Chapter 3) they were similarly distributed across the defined classes over the three years of the study.

There was a significant decrease in the proportion of total test orders that were classed as *monitoring pathology* from 41.3 % (95% CI: 39.7–42.9) in 1998–99 to 37.1% (95% CI: 35.8–38.4). While there was some increase in the proportion classed as *diagnostic pathology* (from 46.1% in 1998–99 to 49.0% in 2000–01) and in those classed as *other pathology* (6.4% to 7.6%), these differences between years 1 and 3 of the study did not reach statistical significance.

However, an investigation of the pathology test rate in relation to the number of problems allocated to each class showed interesting significant changes over time (Table 6.2). The average number of tests ordered in all four classes of pathology rose significantly over the three years of the study.

- *Monitoring pathology*—the number of tests ordered for defined or differentiated conditions increased significantly from 15.7 (95% CI: 14.8–16.5) tests per 100 defined problems in 1998–99 to 17.7 (95% CI: 16.8–18.6) per 100 in 2000–01.
- *Diagnostic pathology*—the average number of tests ordered for undifferentiated problems also increased significantly, from 16.8 (95% CI: 15.9–17.7) to 21.1 (95% CI: 20.0–22.2) per 100 problems of this type between 1998–99 and 2000–01.
- *Preventive care pathology* also showed an increased rate of tests per 100 problems managed from 24.4 (95% CI: 21.6–27.2) to 30.8 (95% CI: 27.4–34.3) over the study period.
- *Other pathology* also increased significantly over the period of this study, from 13.1 (95% CI: 11.8–14.5) to 18.5 (95% CI: 16.3–20.5) per 100 problems labelled in this manner.

Though some of these changes may seem small, they represent increases in relative rates of number of tests ordered per 100 problems of:

- 13% for differentiated conditions (*monitoring pathology*)
- 26% of pathology ordered for undifferentiated conditions (*diagnostic pathology*)
- 26% for *preventive care pathology* (pathology undertaken for checkups with no defined condition or symptom label)
- 41% for problems with ill-defined process labels (such as 'pathology test', 'blood test').

Table 6.1: Distribution of pathology test orders (excluding Pap smears) by class (weighted data), by year

Class	1998–99 Number of problems (*n*)	1998–99 Number path tests ordered (*n*)	1998–99 Per cent path tests (*n*=22,982) (95% CI)	1999–00 Number of problems (*n*)	1999–00 Number path tests ordered (*n*)	1999–00 Per cent path tests (*n*=26,800) (95% CI)	2000–01 Number of problems (*n*)	2000–01 Number path tests ordered (*n*)	2000–01 Per cent path tests (*n*=28,516) (95% CI)
Differentiated/monitoring pathology	60,634	9,495	41.3 (39.7–42.9)	64,592	10,683	39.9 (38.3–41.4)	59,804	10,577	37.1 (35.8–38.4)
Undifferentiated/diagnostic pathology	63,120	10,592	46.1 (44.5–47.7)	69,687	12,385	46.2 (44.5–47.9)	66,099	13,965	49.0 (47.4–50.6)
Preventive care pathology	5,796	1,413	6.1 (5.4–6.9)	6,745	1,777	6.6 (5.8–7.5)	5,829	1,797	6.3 (5.6–7.0)
Other pathology	11,273	1,482	6.4 (5.8–7.1)	12,833	1,956	7.3 (6.6–8.0)	11,796	2,176	7.6 (6.7–8.5)
Total	**140,824**	**22,982**	**100.0**	**153,857**	**26,800**	**100.0**	**143,528**	**28,516**	**100.0**

Note: CI—confidence interval; shading indicates significant differences between study years.

Table 6.2: Class-specific pathology test ordering rates (excluding Pap smears) (weighted data), by year

Class	1998–99 Class-specific pathology rate[a]	1998–99 Per cent of problems 1+ pathology[b]	1998–99 Path test rate per 100 problems[c]	1999–00 Class-specific pathology rate[a]	1999–00 Per cent of problems 1+ pathology[b]	1999–00 Path test rate per 100 problems	2000–01 Class-specific pathology rate[a]	2000–01 Per cent of problems 1+ pathology[b]	2000–01 Path test rate per 100 problems
Differentiated/ monitoring pathology	15.7 (14.8–16.5)	8.7 (8.3–9.1)	6.7	16.5 (15.6–17.5)	8.9 (8.5–9.4)	6.9	17.7 (16.8–18.6)	8.7 (8.4–9.1)	7.4
Undifferentiated/ diagnostic pathology	16.8 (15.9–17.7)	9.3 (8.9–9.7)	7.5	17.8 (16.8–18.7)	9.7 (9.3–10.1)	8.0	21.1 (20.0–22.2)	10.3 (9.8–10.7)	9.7
Preventive care pathology	24.4 (21.6–27.2)	11.7 (10.5–12.9)	1.0	26.3 (23.3–29.3)	12.7 (11.5–14.0)	1.2	30.8 (27.4–34.3)	13.6 (12.3–14.8)	1.3
Other pathology	13.1 (11.8–14.5)	8.4 (7.9–8.8)	1.1	15.2 (13.7–16.6)	9.2 (8.5–10.0)	1.3	18.5 (16.3–20.5)	9.5 (8.7–10.3)	1.5

(a) The number of pathology tests ordered per 100 problems of this type.

(b) The per cent of problems of this type for which at least one pathology test was ordered.

(c) The rate of pathology tests of this type per 100 total problems. *Note:* Shading indicates significant differences between study years.

6.2 The proportion of problems tested in each class

It is notable that the only group of pathology–problem combinations in which there was a significant increase in the proportion of problems for which at least one pathology test was ordered was the undifferentiated conditions for which *diagnostic pathology* may be required. The proportion of these problems investigated with at least one pathology test increased from 9.3% (95% CI: 8.9–9.7) in 1998–99 to 10.3% (95% CI: 9.8–10.7) in 2000–01 (Table 6.2).

6.3 Discussion

In Chapter 3 it was shown that the overall pathology order rate had increased from 16.3 per 100 problems managed to 19.9 per 100 between 1998–99 and 2000–01, an increase of about 22%. The measured increase in the number of pathology tests ordered is reflected in all types of pathology ordering, that for *monitoring pathology*, *diagnostic pathology*, *preventive care pathology* and *other pathology*. However, the distribution of pathology tests across class has remained relatively constant, with a slight decrease in the proportion classed as *monitoring pathology*.

This overall 22% increase in pathology test ordering rates was well reflected in the increases in the rates of tests for undifferentiated conditions (*diagnostic pathology*) (26% increase) and rates of *preventive care pathology* (26%). In contrast, the increase in the rate of *monitoring pathology* (13%) did not reflect the overall increase, while the increase in the rate of *other pathology* rose at double the average rate (41%). The large increase in *other pathology* and smaller increase in *monitoring pathology* directly caused the slight change in distribution of pathology–problem combinations across classes noted earlier.

The definitions applied in this section are far from perfect. They are dependent on the label chosen by the GP to describe the problem under management. When a GP records the problem as 'check-up,' an associated pathology order would be classified as *preventive care pathology*. However, the patient may have an underlying condition for which the GP is ordering a check-up. In this case the pathology would have been better classed as *monitoring pathology*.

An example of this type of labelling recently arose in discussions with a participating GP. The patient had hypertension, which was fully controlled by medication and the patient came for a regular blood pressure check and repeat prescriptions. The GP found the patient remained normotensive on medication. The GP stated s/he was loath to record the problem as 'hypertension' since the patient was no longer hypertensive and wished to record the problem as 'check-up'.

There also appears to be an increasing trend in BEACH for GPs to more frequently record the problem under management in terms of the process of care: that is, in terms such as 'blood test' or 'pathology test' rather than in terms of a symptom or diagnosis. When such process terms are used, the related pathology order is by necessity classed as *other pathology*.

However, these may well be *monitoring pathology* for a condition already defined but which is under control through current treatment (such as the hypertension discussed above). It also appears that orders for lipid tests are increasingly being related (on the recording form) to problem labels such as 'blood test'. These could reflect the fact that more patients who are 'at risk' (such as those with ischaemic heart disease) are now receiving lipid-lowering agents as a preventive even though their cholesterol level is not above normal.[23] The GP may send the patient off for a series of blood tests to monitor their progress and include the lipid test. However, since the patient does not have hypercholesterolaemia, they see the problem as purely 'blood test' rather than linking the test to the underlying problem of (in this case) ischaemic heart disease.

Unfortunately whether data are collected through patient medical record, paper-based recording such as BEACH or directly through electronic health records these labelling and linkage issues will remain to muddy the waters in interpretation of the meaning of changes in behaviour over time.

7 Pathology ordering and problems managed

This chapter investigates the relationship between pathology ordering and morbidity under management over time. The objective is to identify any commonly managed problems that have demonstrated a change in pathology ordering rates over the period of the study.

7.1 Pathology test ordering rates for selected problems over time

Table 7.1 shows the morbidity-specific ordering rates for each of the more common problems managed in general practice for which pathology is frequently ordered. These problems were identified on the basis of the results of the earlier investigation into GP pathology ordering patterns.[1]

There were five problems that showed significant increases in pathology ordering rates between 1998–99 and 2000–01. The right-hand column of this table provides an estimate of the extrapolated national additional number of tests ordered in 2000–01 compared with 1998–99, based on the relative rate of management of each problem over the three years of the study[8] and on the increases in pathology ordering rates shown in Table 7.1.

The problems for which significant increases in pathology test orders were apparent were:

- cardiac check-up, for which the relative rate of pathology orders increased from 8.9 per 100 problem contacts (95% CI: 5.9–11.9) in 1999–00, to 17.2 per 100 (95% CI: 12.1–22.2) in 2000–01. Note that there was no significant increase in pathology test rates for this problem between 1998–99 and 1999–00.
- hypertension, for which the rate of pathology orders increased from 11.9 (95% CI: 10.4–13.4) per 100 problem contacts to 20.4 (95% CI: 18.1–22.7) per 100 problem contacts, an increase of about 70%. This result suggests that, compared with 1998–99, in 2000–01 GPs ordered an additional 730,000 tests for the management of hypertension.
- diabetes, for which the relative rate of pathology tests ordered increased from 47.5 (95% CI: 42.2–52.8) to 60.1 (95% CI: 54.1–66.1) per 100 problem contacts, an increase of approximately 26%. This suggests that, compared with 1998–99, in 2000–01 GPs ordered an additional 350,000 tests for the management of diabetes.
- menopausal symptoms and complaints. The pathology test ordering rate increased from 17.5 per 100 problem contacts (95% CI: 12.9–22.2) to 28.2 per 100 (95% CI: 22.7–33.7) and, while this change was large, the wide confidence intervals suggest there was a high level of clustering around a smaller group of GPs than for some other problems. However, irrespective of the wide confidence interval, this result suggests an additional 150,000 pathology tests were ordered by GPs in 2000–01 (compared with 1998–99) in the management of menopausal symptoms.
- ischaemic heart disease, though the significance was again marginal (judged from the confidence intervals). The pathology ordering rate for ischaemic heart disease increased from 22.4 (95% CI: 17.7–27.1) tests per 100 problem contacts to 33.1 (95% CI: 27.1–39.2).

The extrapolated increase in national test orders over the period would be approximately 140,000 additional tests in the last, versus the first, year of this study.

These results suggest that these five problems have together accounted for an additional 1.5 million pathology test orders by GPs nationally in 2000–01 compared with 1998–99.

Table 7.1: Pathology ordering rates (excluding Pap smears) per 100 contacts for selected common problems (weighted data), by year

Problem	Pathology tests ordered per 100 problems contacts (95% CI)			Extrapolated increase nationally in 2000–01 compared with 1998–99
	1998–99	1999–00	2000–01	
Depression*	8.6 (6.2–11.0)	9.7 (6.2–11.0)	8.7 (7.7–11.8)	—
Cardiac check-up*	10.8 (7.6–14.0)	8.9 (5.9–11.9)	17.2 (12.1–22.2)	116,000
Hypertension*	11.9 (10.4–13.4)	15.8 (13.6–17.9)	20.4 (18.1–22.7)	731,000
Gastroenteritis, presumed infection	16.9 (12.2–21.6)	13.8 (9.9–17.7)	14.1 (9.9–18.3)	—
Menopausal symptom/complaint	17.5 (12.9–22.2)	24.3 (19.0–29.6)	28.2 (22.7–33.7)	150,000
Malignant neoplasm skin	20.3 (17.0–23.7)	22.1 (18.2–25.9)	23.0 (18.9–27.2)	—
Ischaemic heart disease*	22.4 (17.7–27.1)	23.0 (18.5–27.6)	33.1 (27.1–39.2)	140,000
Arthritis*	25.3 (17.1–33.5)	25.2 (16.5–33.9)	25.1 (17.2–32.9)	—
Viral disease NOS	28.3 (22.3–34.3)	24.8 (18.6–30.9)	20.4 (15.5–25.3)	—
Pre-postnatal check-up*	32.3 (25.2–39.5)	42.8 (33.9–51.6)	35.7 (28.0–43.4)	—
Menstrual problems*	35.5 (28.2–42.7)	41.2 (34.1–48.5)	52.0 (41.3–62.7)	—
General check-up*	45.9 (38.6–53.2)	44.5 (37.4–51.6)	59.5 (50.6–68.4)	—
Diabetes*	47.5 (42.2–52.8)	44.0 (38.9–49.1)	60.1 (54.1–66.1)	350,000
Pregnancy*	50.4 (42.1–58.8)	52.4 (43.3–61.6)	57.6 (49.8–65.3)	—
Lipid disorder	53.3 (48.1–58.2)	54.7 (49.5–59.8)	62.3 (56.1–68.4)	—
Urinary tract infection*	54.0 (49.9–58.2)	55.6 (52.0–59.3)	62.8 (58.1–67.5)	—
Thyroid problems*	60.5 (52.5–68.5)	62.4 (55.1–69.8)	66.6 (57.2–76.0)	—
Weakness/tiredness general	152.3 (136.4–168.2)	160.4 (141.4–179.5)	170.4 (147.9–193.0)	—

* Includes multiple ICPC-2 or ICPC-2 PLUS codes (see Appendix 3).

Note: CI—confidence interval; NOS—not otherwise stated; shading indicates significant differences between study years.

Though trends were apparent for increases in pathology ordering rates for other conditions, these changes did not reach statistical significance. Nevertheless, the measured changes for these problems may still have had a significant impact on GP pathology test ordering rates (e.g. in combination). They included:

- menstrual problems (a 44% increase from 36 to 52 tests per 100 problems)
- general check-ups (a 30% increase from 46 to 60 tests per 100 problem contacts)
- lipid disorders (a 17% increase from 53 to 62 tests per 100 problem contacts)
- urinary tract infections (a 17% increase from 54 to 63 tests per 100 problem contacts)

and to a lesser degree:

- weakness/tiredness (a 12% increase from 152 to 170 tests per 100 problem contacts)
- thyroid problems (a 10% increase from 61 to 67 tests per 100 problem contacts).

The changes in pathology ordering rates for each of these relatively commonly managed problems are presented graphically in Figure 7.1.

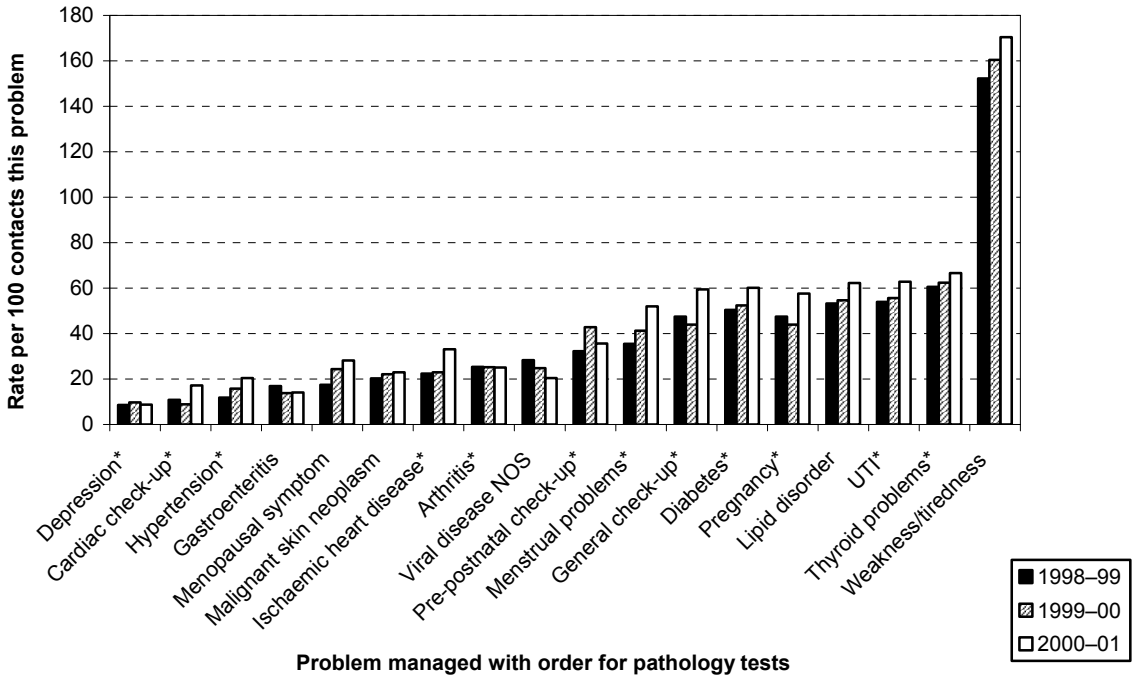


Figure 7.1 : Pathology ordering rates per 100 problem contacts for selected common problems.

* Includes multiple ICPC-2 or ICPC-2 PLUS codes (see Appendix 3).

Note: NOS—not otherwise specified; UTI—urinary tract infection.

The changes in pathology ordering rates demonstrated in Table 7.1 are limited in some cases by relatively small sample sizes and the simplicity of the statistical approach of use of confidence intervals to test significance in changes over time. In Table 7.2 some wider problem groups are investigated using linear regression as a better test of significant changes over time in pathology ordering rates for specific types of conditions. The groups were

selected on the basis of findings from the earlier pathology report[1], in combination with the findings demonstrated above.

Multiple regression was used to test whether pathology ordering had changed over time depending on the problem. Time by problem interaction terms were created to test whether the type of problem managed modified the effect of time on pathology ordering rates (i.e. did the rate of change over time in ordering rates vary according to the particular problem under management?).

As shown in Table 7.2 this analysis demonstrated that the rate of pathology test orders for blood pressure problems and other cardiovascular problems increased significantly more rapidly over time than for other problems (time by blood pressure, $p<0.0001$, time by other cardiovascular, $p=0.017$). For diabetes there were some fluctuations in pathology ordering rates, with a large increase seen between 1999–00 and 2000–01. This also resulted in an increase in order rates that was significantly greater than the overall rate of increase (time by diabetes, $p=0.016$).

There were significant increases in test ordering rates over time for lipid disorders, thyroid problems and weakness and tiredness ($p<0.0001$ in each case), although these increases in ordering rates were commensurate with the average rate of increase in pathology test orders over time (time by problem interaction was non-significant). Any increases in ordering rates for lipid disorders, thyroid problems and weakness/tiredness will, however, have a major impact on the total number of pathology tests ordered by GPs because these problems represent the more common problems for which pathology is ordered.

Table 7.2: Pathology test ordering rates (excluding Pap smears) for selected problems over time (weighted data)

	Pathology tests per 100 problems (95% CI)			p-values	
Problem	**1998–99**	**1999–00**	**2000–01**	**Time* problem[(a)]**	**Time (adjusted for problem)[(b)]**
Blood pressure problems*	12.2 (10.7–13.6)	16.1 (14.0–18.2)	20.8 (18.5–23.2)	<0.0001	—
Other cardiovascular morbidity*	24.4 (21.7–27.1)	26.1 (23.4–28.7)	32.8 (29.7–35.8)	0.017	—
Diabetes (all)*	47.5 (42.2–52.8)	44.0 (38.9–49.1)	60.1 (54.1–66.1)	0.016	—
Lipid disorders*	53.3 (48.1–58.6)	54.7 (49.5–59.8)	62.3 (6.1–68.4)	ns	<0.0001
Thyroid problems*	60.5 (52.5–68.5)	62.4 (55.1–69.8)	66.6 (7.2–76.0)	ns	<0.0001
Weakness/tiredness	152.3 (136.4–168.2)	160.4 (141.4–179.5)	170.4 (47.9–193.0)	ns	<0.0001

* Includes multiple ICPC-2 or ICPC-2 PLUS codes (see Appendix 3).

(a) Tests whether the rate of increase in pathology tests orders for this problem or group of problems was significantly greater or less than the rate of increase for other problems.

(b) Tests whether there was a significant increase in pathology test orders over time independent of the management rate of this problem.

Note: CI—confidence interval; ns—not statistically significant; shading indicates significant differences between study years.

The effect of increased rates of pathology test orders and increases in problem management rates

To this point, this report has centred on the relative rate of pathology test orders per 100 problems of a specific type. Also of interest is the question as to whether increases in pathology tests were also reflecting an increase in the number of contacts with more commonly tested problems. That is, even where no increase in pathology ordering rates per 100 problem contacts had occurred, if there was a significant increase in the number of contacts for a commonly tested problem over the period of the study, there would be an increase in total pathology tests ordered.

The relative rate of management of each of the more common problems (listed in Table 7.2) for which pathology is ordered was investigated over the three years of this study (results not presented). The results were as follows:

- blood pressure problems—there was no significant change in the management rate of blood pressure problems between 1998–99 and 2000–01 (p=0.61)
- other cardiovascular morbidity—there was a significant decrease in the relative rate of management of cardiovascular problems other than blood pressure problems of 0.3 per 100 encounters per year (p<0.0001)
- diabetes (all)—there was a significant but marginal increase in the management rate of diabetes of 0.12 contacts per 100 encounters per year (p=0.0448)
- lipid disorders—there was a significant increase in the relative rate of management of lipid disorders of 0.22 per 100 encounters per year (p=0.0003)
- weakness/tiredness— there was no significant change in the relative rate of management of weakness/tiredness over the period of the study (p=>0.05)
- thyroid problems—there was no significant increase in the relative rate of management of thyroid problems between 1998–99 and 2000–01 (p=>0.05).

These results suggest there has been an additive effect on pathology test ordering rates in some cases, from an increase in pathology rates for a problem coupled with an increase in the problem management rates over time.

Example 1: Lipid problems

- The relative rate of pathology tests per 100 contacts with lipid problems increased at the same rate as the overall pathology test orders between 1998–99 and 2000–01 (effect 1), from 53.3 per 100 in 1998–99 to 62.3 in 2000–01.
- There was also been an increase in the management rate of lipid problems in general practice over the same period. This increase of 0.22 per 100 encounters per year would have (through extrapolation) resulted in an additional 220,000 contacts with lipid disorders each year across the country, or an extra 440,000 contacts in 2000–01 compared with 1998–99 (effect 2).
- Combining these two effects, this problem alone would have generated an additional 497,000 pathology test orders nationally in 2000–01 compared with 1998–99.

Earlier research has indicated that the vast majority of the increase in the management rate over the 1998–99 to 2000–01 study period was due to a steady increase in the diagnosis of new cases rather than increased servicing of cases previously diagnosed.[8] This increase in the number of cases identified combined with continued management of those previously

identified means that the increases in pathology ordering outlined above are likely to continue.

Example 2: Diabetes

- The pathology test rate for diabetes problems increased from 47.5 per 100 problems in 1998–99 with diabetes to 60.1 per 100 in 2000–01, and increase of 12.6 tests per 100 over the same period (effect 1).
- The annual increment in the management rate of diabetes was 0.12 contacts per 100 encounters. This increase would have generated an additional 240,000 contacts with diabetes in general practice nationally in 2000–01 compared with 1998–99 (effect 2).
- The combined effect of these changes for diabetes alone would have accounted for an additional 466,000 pathology tests in 2000–01 compared with 1998–99.

It is notable that the increase in pathology test ordering rates was not incremental over the three years of the study. The increase mostly occurred between 1999–00 and 2000–01, and may reflect recent efforts among many Divisions of General Practice to improve the management of diabetes in general practice in their region. It may also be a result of the recent establishment of the Diabetes Register, held by the Australian Institute of Health and Welfare. With the introduction of a new Medicare item number for the management of diabetes, the increase in management rate in the future may be higher than the average 0.12 contacts per 100 encounters per year earlier reported. Further, if increased contacts combine with similar increases in the number of tests ordered per contact, far greater increases in total pathology orders for diabetes could be expected in the coming years.

7.2 Problems most likely to generate 4 or 5 test orders, over time

The results described in Chapter 3 (Table 3.2) demonstrated a significant increase between 1998–99 and 2000–01 in the proportion of problems managed that generated 4 or 5 pathology test orders, from 1.0% to 1.7% of all problems. It must be remembered that the encounter form limits the GP to recording 5 pathology tests.

The problems most likely to generate 4 or 5 tests per episode were investigated for each of the three years of the study. Each of the ten problems accounting for the greatest proportion of these problems in 2000–01 were then selected for investigation of changes in pathology test ordering rates over time.

Together the most common problems for which 4 or 5 tests were ordered accounted for almost 40% (39.2%) of all problems for which 4 or 5 pathology tests were ordered in a single episode (Figure 7.2).

- Weakness/tiredness accounted for the largest proportion of those problems for which 4 or 5 pathology test orders were placed. The rate of ordering of 4 or 5 tests for this problem rose from 0.16 per 100 total encounters in 1998–99 to 0.19 per 100 in 2000–01 (an increase of 19%). Note that this increase occurred between 1999–00 and 2000–01 rather than across the three years of the study.
- There was more than a 100% increase in rate of occurrence of 4 or 5 pathology test orders for hypertension (from 0.08 to 0.17 per 100 encounters). This result is reflected in the earlier findings in this chapter, of an overall significant increase in order rates for hypertension.

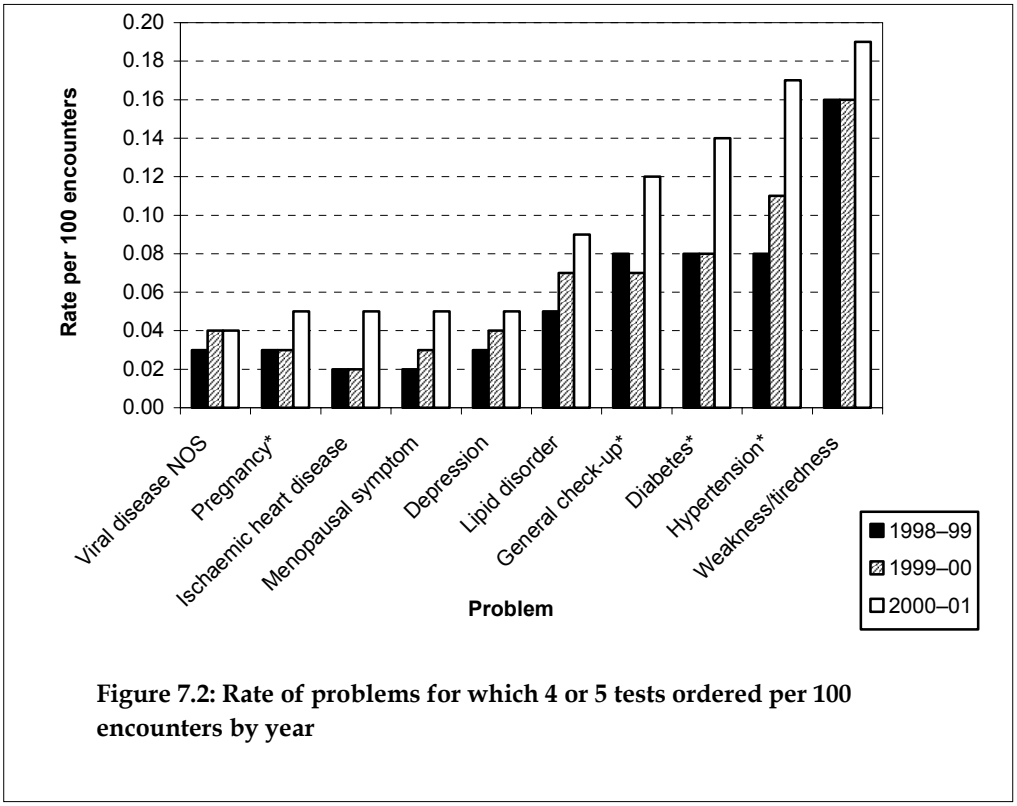


Figure 7.2: Rate of problems for which 4 or 5 tests ordered per 100 encounters by year

* Includes multiple ICPC-2 or ICPC-2 PLUS codes (see Appendix 3).

Note: NOS—not otherwise specified.

- There was almost 100% increase in the relative rate of occurrence of 4 or 5 pathology test orders for diabetes (from 0.08 to 0.14 per 100 encounters). This result is also reflected in the earlier findings in this chapter of an overall significant increase in order rates for diabetes.
- Other problems for which increases in the number of contacts generating 4–5 pathology test orders included:
    - general check-up (from 0.08 to 0.12 per 100 encounters, an increase of 50%)
    - lipid disorder (from 0.05 to 0.09 per 100 encounter, an increase of 80%)
    - depression (from 0.03 to 0.05 per 100 encounters, an increase of 66%)
    - menopausal symptoms and complaints (from 0.02 to 0.05 per 100 encounters, an increase of 150%)
    - ischaemic heart disease (from 0.02 to 0.05 per 100 encounters, an increase of 150%)
    - pregnancy (from 0.03 to 0.05 per 100 encounters, an increase of 66%)
    - viral disease (not otherwise specified) (from 0.03 to 0.04 per 100 encounters, an increase of 33%).

This section has demonstrated the increasing trend for GPs to order 4–5 tests per problem and has defined the problems that account for the largest proportion of these tests. However, this move to high numbers of test orders per episode has mostly occurred between 1999–00 and 2000–01, rather than between the first two years of the BEACH program.

8 The relationship between pathology ordering and other management

It was hypothesised that there may be a relationship between pathology test ordering and other management techniques. For example, the increases in pathology ordering rates over time may reflect decreased use of other management techniques such as prescriptions for medication. If that were the case, the increased pathology test ordering rate and its increased costs to the Commonwealth Government may be offset by decreases in other costs, such as those for pharmaceuticals paid through the Pharmaceutical Benefits Scheme, or for specific therapeutic procedures or imaging (paid through the MBS).

This chapter investigates the relationship between pathology ordering and the prescribing of medications, ordering of imaging, conduct of therapeutic procedures and provision of clinical treatments, such as advice and counselling.

8.1 The relationship between pathology ordering and prescribing

There was an inverse relationship between prescribing and pathology test orders, such that the more pathology tests ordered for a problem, the fewer medications were prescribed. For example, in 1998–99, problems for which no pathology tests were ordered had an average prescribing rate of 78 medications per 100 problems, whereas those problems for which five pathology tests were ordered had an average prescribing rate of 38.8 prescriptions per 100 problems (Table 8.1).

A significant relationship was also found between the number of pathology tests ordered and whether or not any medication was prescribed. The proportion of problems for which at least one medication was prescribed decreased steadily as the number of pathology tests ordered increased. For example, in each of the years studied at least one medication was prescribed for about 60% of the problems for which no pathology was ordered and for about one in three problems for which four or five pathology tests were ordered.

Linear regression with medication rates as the outcome confirmed a significant inverse relationship between number of pathology tests and number of medications per problem; as the number of tests per problem increased the number of medications decreased ($p<0.0001$). There was, however, no significant change in overall medication rates over time ($p=0.51$). This is because by far the majority of problem contacts did not generate any pathology test orders and these problems also accounted for the majority of medications. Therefore the observed increase in pathology rates over time did not have a significant impact on the overall prescribing rate of medications over time.

Table 8.1: The relationship between number of pathology tests ordered and prescribing (weighted data), by year

Number of pathology tests ordered for problem	1998–99		1999–00		2000–01	
	Per cent 1+ scripts (95% CI)[(a)]	Script rate per 100 problems (95% CI)	Per cent 1+ scripts (95% CI)[(a)]	Script rate per 100 problems (95% CI)	Per cent 1+ scripts (95% CI)[(a)]	Script rate per 100 problems (95% CI)
No pathology	61.1 (60.2–62.0)	78.0 (76.6–79.3)	60.2 (59.3–61.1)	77.7 (76.0–79.1)	60.8 (59.8–61.8)	77.4 (75.9–78.9)
One pathology test	42.2 (40.4–44.0)	52.3 (49.7–54.9)	40.5 (38.5–42.6)	50.3 (47.7–53.0)	41.5 (39.6–43.4)	53.1 (50.1–56.0)
Two pathology tests	37.7 (35.1–40.3)	51.1 (47.2–55.1)	38.2 (35.7–40.9)	51.3 (46.8–55.8)	39.0 (36.3–41.8)	52.2 (47.9–56.4)
Three pathology tests	36.4 (33.4–39.4)	53.7 (47.2–60.3)	33.9 (31.0–36.7)	45.5 (41.1–49.8)	38.0 (35.0–40.9)	51.2 (46.5–55.9)
Four pathology tests	32.1 (28.0–36.2)	42.2 (36.1–48.3)	33.3 (29.3–37.2)	46.3 (40.2–52.3)	33.0 (29.6–36.3)	45.0 (39.9–50.1)
Five pathology tests	30.5 (25.7–35.3)	38.8 (32.1–45.6)	28.3 (23.5–33.1)	42.9 (30.4–55.4)	29.7 (25.9–33.5)	38.7 (33.4–44.1)
Total	**59.1 (58.3–60.0)**	**75.5 (74.1–76.9)**	**58.1 (57.2–59.0)**	**75.0 (73.6–76.4)**	**58.7 (57.7–59.6)**	**74.8 (73.3–76.3)**

(a) The percentage of problems in each pathology category for which at least one prescription was provided on that occasion.

Note: Scripts—prescriptions; CI—confidence interval.

8.2 The relationship between imaging and pathology ordering

There was a linear relationship between imaging orders and pathology test orders such that the more pathology tests ordered for a problem, the more imaging tests ordered. For example, in 2000–01, problems for which no pathology tests were ordered had an average rate of 8.5 imaging tests ordered per 100 problems, while those problems for which five pathology tests were ordered had an average of 21.1 imaging tests ordered per 100 problems.

A linear relationship was also found between the number of pathology tests ordered and the likelihood of ordering any imaging. The proportion of problems for which at least one order for imaging was placed increased steadily as the number of pathology tests ordered increased. For example, in 2000–01 at least one imaging test was ordered for 7.8% of problems managed while 17.2% of problems associated with five pathology tests generated at least one imaging test order (Table 8.2).

Changes over time

While there was a significant increase in the number of imaging tests ordered between 1998–99 (7.7 per 100 problems managed, 95% CI: 7.3–8.2) and 2000–01 (9.1 per 100, 95% CI: 8.6–9.5) this increase was more apparent for problems for which no pathology tests were ordered. For these problems the imaging order rate increased significantly from 7.2 per 100 problems (95% CI: 6.8–7.6) to 8.5 per 100 (95% CI: 8.1–8.9) while the increases over time for problems associated with pathology orders were far less (Table 8.2).

However, these measured increases may not be accurate. In 1998–99 the GPs were offered three options in the imaging section of the form: plain x-ray, US/CT/Contrast and other

imaging, and for each option selected they were asked to specify the body site of the image. In 1999–00 the coding system for imaging orders was developed to provide greater specificity. From that time GPs were asked to record free text descriptions of imaging ordered. This allowed the recording of multiple imaging of any type. The measured increase in imaging tests ordered could merely be reflecting this change from the simple coding system in 1998–99 to the more specific in 2000–01.

Multiple regression was therefore conducted using the percentage of problems for which at least one imaging test was ordered as the outcome (rather than number of imaging tests ordered). The regression confirmed the significant linear relationship between proportion of problems generating an order for imaging and the number of pathology tests per problem ($p<0.0001$). However, the proportion of problems for which imaging was ordered also increased significantly over time, independently of pathology ordering (time adjusted for pathology rates, $p=0.0004$). It is therefore unlikely that the increase in pathology ordering rates over time explains the increase in total imaging problems.

Table 8.2: The relationship between number of pathology tests ordered and imaging orders (weighted data), by year

	1998–99		1999–00		2000–01	
Number of pathology tests ordered for problem	**Per cent 1+ imaging (95% CI)[(a)]**	**Imaging per 100 problems (95% CI)**	**Per cent 1+ imaging (95% CI)[(a)]**	**Imaging per 100 problems (95% CI)**	**Per cent 1+ imaging (95% CI)[(a)]**	**Imaging per 100 problems (95% CI)**
No pathology	6.4 (6.0–6.7)	7.2 (6.8–7.6)	6.7 (6.4–7.1)	7.8 (7.4–8.2)	7.3 (6.9–7.6)	8.5 (8.1–8.9)
One pathology test	8.9 (8.0–9.8)	9.9 (8.8–11.0)	8.7 (7.9–9.6)	9.9 (8.8–10.9)	9.3 (8.0–10.2)	10.7 (9.6–11.9)
Two pathology tests	13.8 (11.6–16.1)	16.6 (13.5–19.6)	12.2 (10.5–13.9)	14.3 (12.1–16.6)	14.1 (12.5–15.9)	16.4 (14.2–18.6)
Three pathology tests	15.1 (13.0–17.2)	17.3 (14.7–19.9)	15.3 (13.0–17.6)	18.9 (15.8–22.0)	16.2 (14.2–18.1)	19.2 (16.7–21.6)
Four pathology tests	15.1 (12.0–18.1)	17.4 (13.6–21.2)	15.8 (12.9–18.7)	19.5 (15.6–23.5)	16.2 (13.7–18.8)	20.0 (16.6–23.4)
Five pathology tests	15.3 (11.9–18.7)	18.2 (14.1–22.3)	16.1 (12.6–19.6)	19.4 (15.3–23.5)	17.2 (13.4–20.9)	21.1 (16.4–25.8)
Total	**6.8 (6.5–7.1)**	**7.7 (7.3–8.2)**	**7.1 (6.8–7.5)**	**8.3 (7.8–8.7)**	**7.8 (7.4–8.1)**	**9.1 (8.6–9.5)**

(a) The percentage of problems in each pathology category for which at least one imaging test was ordered on that occasion.

Note: CI—confidence interval.

8.3 The relationship between therapeutic procedures and pathology orders over time

There appeared to be little relationship between the number of therapeutic procedures undertaken in the management of a problem and the number of pathology tests ordered. The only relationship of interest was that where a single pathology test was ordered there was a greater likelihood of a therapeutic procedure being performed (9.6% of problems in 2000–01 with one pathology test, 95% CI: 8.5–10.6) compared with problems for which no pathology was ordered (7.4%, 95% CI: 7.0–7.8) and compared with those generating more than one pathology test (e.g. 4.4% of those problems with five pathology tests, 95% CI: 3.0–5.8) (Table 8.3).

Table 8.3: The relationship between number of pathology tests ordered and therapeutic procedures undertaken (weighted data), by year

Number of pathology tests ordered for problem	1998–99		1999–00		2000–01	
	Per cent 1+ procedures (95% CI)[(a)]	Procedures per 100 problems (95% CI)	Per cent 1+ procedures (95% CI)[(a)]	Procedures per 100 problems (95% CI)	Per cent 1+ procedures (95% CI)[(a)]	Procedures per 100 problems (95% CI)
No pathology	7.4 (7.0–7.8)	7.9 (7.4–8.3)	7.5 (7.2–7.9)	8.0 (7.6–8.4)	7.4 (7.0–7.8)	7.9 (7.5–8.3)
One pathology test	7.9 (7.1–8.7)	8.4 (7.5–9.3)	9.2 (8.2–10.1)	9.8 (8.7–10.9)	9.6 (8.5–10.6)	10.3 (9.1–11.5)
Two pathology tests	3.3 (2.4–4.2)	3.3 (2.5–4.3)	4.2 (3.3–5.2)	4.5 (3.4–5.6)	4.3 (3.3–5.3)	4.4 (3.4–5.5)
Three pathology tests	3.7 (2.6–4.8)	3.9 (2.7–5.0)	5.0 (3.3–6.6)	5.3 (3.5–7.2)	3.4 (2.6–4.3)	3.6 (2.7–4.6)
Four pathology tests	3.6 (2.1–5.0)	3.7 (2.2–5.2)	4.5 (2.9–6.1)	5.1 (3.3–6.9)	4.6 (3.3–5.8)	4.6 (3.3–5.9)
Five pathology tests	4.1 (1.8–6.4)	4.2 (1.7–6.7)	3.7 (2.2–5.1)	3.9 (2.4–5.5)	4.4 (3.0–5.8)	4.9 (3.2–6.6)
Total	**7.3 (6.9–7.6)**	**7.7 (7.3–8.2)**	**7.5 (7.2–7.9)**	**8.0 (7.6–8.3)**	**7.4 (7.0–7.8)**	**7.8 (7.4–8.3)**

(a) The percentage of problems in each pathology category for which at least one therapeutic procedure was undertaken on that occasion.

Note: CI—confidence interval.

8.4 The relationship between provision of clinical treatments and pathology ordering

Table 8.4 demonstrates the relative rates of provision of clinical treatments (such as counselling, lifestyle advice etc.) per 100 problems depending on the number of pathology tests ordered. There was little variation in the rates of clinical treatment for those problems for which no pathology was ordered and for those with multiple pathology tests ordered.

Multiple regression confirmed there was not a significant relationship between the number of pathology tests ordered and the use of clinical treatments (p=0.0352).

Changes over time

While there was a significant increase in the rates of provision of clinical treatments from 21.6 per 100 problems (95% CI: 20.5–22.7) in 1998–99 to 25.8 per 100 (95% CI: 24.4–27.2) in 2000–01 (p<0.0001) we can conclude that this increase is not related to whether or not pathology is ordered nor to the number of pathology tests ordered for the problem.

Table 8.4: The relationship between number of pathology tests ordered and provision of clinical treatment (weighted data), by year

Number of pathology tests ordered for problem	1998–99		1999–00		2000–01	
	Per cent 1+ clinical treatment (95% CI)[(a)]	Clinical treatments per 100 problems (95% CI)	Per cent 1+ clinical treatment (95% CI)[(a)]	Clinical treatments per 100 problems (95% CI)	Per cent 1+ clinical treatment (95% CI)[(a)]	Clinical treatments per 100 problems (95% CI)
No pathology	20.0 (19.0–20.9)	21.8 (20.7–22.8)	20.9 (20.0–21.9)	23.0 (21.9–24.1)	23.1 (21.9–24.2)	26.1 (24.7–27.7)
One pathology test	16.9 (15.4–18.4)	18.7 (16.9–20.4)	16.8 (15.0–18.7)	18.8 (16.7–20.7)	17.5 (15.9–19.1)	20.0 (18.1–22.0)
Two pathology tests	17.3 (15.2–19.5)	19.8 (17.2–22.3)	21.0 (18.5–23.4)	24.5 (21.4–27.5)	20.1 (17.6–22.6)	24.1 (20.8–27.3)
Three pathology tests	21.2 (18.4–24.1)	23.5 (20.3–26.7)	21.9 (19.4–24.4)	25.2 (22.0–28.3)	22.5 (19.9–25.1)	27.3 (23.7–30.8)
Four pathology tests	18.3 (14.9–21.6)	20.3 (16.5–24.1)	22.1 (18.6–25.6)	25.0 (20.9–29.2)	20.9 (17.8–23.9)	24.4 (20.6–28.2)
Five pathology tests	22.3 (17.4–27.3)	24.2 (18.9–29.5)	21.2 (17.1–25.5)	24.0 (19.2–28.7)	20.7 (17.7–23.7)	24.8 (20.8–28.9)
Total	**19.8 (18.8–20.7)**	**21.6 (20.5–22.7)**	**20.7 (19.8–21.7)**	**22.8 (21.7–23.9)**	**22.7 (21.6–23.8)**	**25.8 (24.4–27.2)**

(a) The percentage of problems in each pathology category for which at least one clinical treatment was provided on that occasion.

Note: Scripts—prescriptions, CI—confidence interval.

8.5 Conclusion

From the above results we can conclude that while there is an inverse relationship between pathology test ordering and pharmaceutical prescribing, and a positive relationship between pathology ordering and imaging test orders, these relationships did not have a significant impact on the total number of medications prescribed, the total number of imaging tests ordered or the total number of therapeutic procedures undertaken. This is probably because pathology tests are only ordered at about one in ten encounters so, in spite of these significant relationships, their impact on overall rates of other clinical activities is relatively small.

9 The relationship between length of consultation and pathology ordering

This chapter investigates the relationship between length of consultation and GP ordering of pathology. Two approaches are used. The first investigates the relationship between Medicare item of service and pathology ordering rates. The second investigates the relationship between length of consultations in minutes (calculated from subsamples of encounters in each year) and pathology test ordering rates.

9.1 Pathology ordering and Medicare item number recorded

Those encounters for which a Medicare A1 item of service was recorded as claimable were selected from the total three-year data set. These were then divided into four groups: Medicare Level A (short consultations), Level B (standard), Level C (long), Level D (prolonged).

Table 9.1 shows there was no significant change in the distribution of encounters across Medicare item levels (for levels A, B, C and D) over the three years of this study, almost 90% of these encounters being claimable as Level B in each year. There was a strong linear relationship between Medicare item level and pathology test ordering rates, the relative rate of pathology test orders increasing with each step in the Medicare item level claimed. For example, in 2000–01 pathology was ordered at an average rate of 8.4 tests per 100 encounters claimed at Level A. This increased to 25.6 tests per 100 Level B and 65.7 tests per 100 encounters claimed at Medicare Level C, and this rate remained steady (60.8 per 100) for those claimed at Level D. The results of multiple regression supported this relationship. The Medicare item level was found to be a significant predictor of the number of pathology tests ordered ($p<0.0001$).

The results also demonstrate that there was a significant increase in the pathology test ordering rate at Medicare Level B (from 21.3 tests per 100 encounters in 1998–99 to 25.6 per 100 in 2000–01) and Level C (56.6 to 65.7 tests per 100) encounters. However, there was no significant change in the relative rate of pathology tests ordered over time at Medicare Level D encounters.

In Table 9.2, the trend to increased number of tests ordered per pathology encounter is again apparent. After the decision to order pathology had been made, GPs demonstrated a significant increase in the number of tests ordered at Level B Medicare encounters (from 191 per 100 pathology encounters to 213 per 100 between the second and third years of this study), and for Level C encounters from 240 per 100 pathology encounters to 276 per 100 in the same time period. The strong linear relationship between Medicare item level and pathology ordering (shown above), was also apparent in the proportion of encounters generating at least one pathology test order. Of the consultations designated as Level A, 6.1% generated at least one pathology test, compared with 12.2% of those designated Level B, 25.1% of Level C and 23.8% of Level D (results not shown). However, there was no significant change over time in this pattern.

The lack of any significant change in the pattern of claims across Medicare item levels and in the likelihood of the GP ordering pathology at any specific item number level suggest that while the number of pathology tests ordered is strongly related to the complexity (or length) of the consultation, this relationship cannot explain the increase of total pathology tests ordered over time.

Table 9.1: The relationship between the Medicare A1 item number claimed and the number of pathology tests ordered (weighted data), by year

	Distribution of A1 Medicare encounters by group per cent (95% CI)			Pathology tests ordered per 100 encounters (95% CI)		
Medicare claim level	**1998–99**	**1999–00**	**2000–01**	**1998–99**	**1999–00**	**2000–01**
Medicare Level A encounters	1.6 (1.4–1.8)	1.5 (1.2–1.9)	1.7 (1.3–2.1)	10.4 (7.0–13.8)	8.1 (4.9–11.3)	8.4 (5.3–11.5)
Medicare Level B encounters	89.5 (88.8–90.2)	88.6 (87.9–89.4)	88.2 (87.4–89.0)	21.3 (20.2–22.3)	22.7 (21.6–23.7)	25.6 (24.4–26.9)
Medicare Level C encounters	8.2 (7.6–8.9)	9.2 (8.5–9.8)	9.4 (8.7–10.0)	56.6 (52.2–60.9)	60.9 (56.5–65.3)	65.7 (61.5–70.0)
Medicare Level D encounters	0.7 (0.5–0.8)	0.7 (0.5–0.8)	0.7 (0.6–0.8)	64.8 (40.5–89.1)	69.0 (50.5–87.6)	60.8 (46.8–74.8)

Note: CI—confidence interval; shading indicates significant differences between study years.

Table 9.2: Pathology test ordering rates at pathology encounters by Medicare item level (weighted data), by year

	Tests per 100 encounters at which pathology test ordered Per cent (95% CI)		
Medicare claim level	**1998–99**	**1999–00**	**2000–01**
Medicare Level A encounters	157 (143–128)	132 (103–160)	154 (126–182)
Medicare Level B encounters	185 (180–190)	191 (186–196)	213 (209–218)
Medicare Level C encounters	236 (226–246)	240 (231–250)	276 (253–299)
Medicare Level D encounters	258 (142–317)	283 (254–313)	276 (245–307)
Mean	192 (188–196)	197 (193–202)	221 (216–225)

Note: CI—confidence interval; shading indicates significant differences between study years.

It was thought that the relationship between the Medicare item number and pathology ordering rates may merely reflect an underlying relationship between Medicare item number (i.e. consultation length and/or complexity) and the number of problems managed and/or the number of new problems managed at the encounter. However, multiple regression analyses indicated that the Medicare item level remained a significant predictor of the number of pathology tests ordered, independent of the number of problems managed or the number of new problems managed ($p<0.0001$) (data not shown).

In fact, year of the study, number of problems and item number were each significant predictors of the number of tests ordered ($p<0.0001$). However, time also remained an independent predictor of pathology ordering above and beyond the effect of item number and number of problems managed. This seems to indicate that while the Medicare item number, number of problems managed and number of new problems managed all contributed independently to the number of pathology tests ordered, there remains an increase in pathology ordering over time, that is not explained by the number of problems managed or the type of consultation.

9.2 Length of consultation (in minutes) and pathology ordering rates

As earlier described in Chapter 2—Methods, for a subsample of encounters in 1999–00 and 2000–01 GPs were asked to record the start and finish time for each consultation. This provided a measured length of consultation in minutes.

The total number of encounters available for analysis was 10,939 in 1998–99, 10,029 in 1999–00 and 38,556 in 2000–01 (total unweighted = 59,524). The results of linear regression supported the earlier findings of a relationship between Medicare item level and pathology ordering. There was a strong and significant relationship between timed length of consultations and pathology test orders ($p<0.0001$). This relationship remained significant after adjustment for the number of problems managed ($p<0.0001$). However, there was no change in mean consultation length in 1999–00 and 2000–01 (the two years for which these subsamples were available) ($p=0.2777$). Therefore the proven relationship between consultation length and pathology ordering did not have any impact on the changes in total pathology tests ordered over time.

10 Analysis of variance in pathology ordering rates

Elsewhere in this report a number of factors have been demonstrated to be associated with pathology ordering rates. This chapter investigates the extent to which these factors explain the variance in GP ordering rates and test the extent to which time itself contributes to changes in these rates. Factors earlier identified as affecting GP pathology ordering rates were explored using analysis of variance and linear regression. The variables of interest are listed below. Of the 3,030 GPs, 2,905 (95.9%) had data recorded for all the variables of interest. The analysis of variance was restricted to these 2,905 GPs and was performed on unweighted data because GP weighting variables (GP age and GP sex) were adjusted for in the analysis.

- **GP characteristics**
  Sex of GP
  Age of GP
  Years in practice
  No of sessions per week
  Place of graduation (Australia, New Zealand, other)
- **Practice characteristics**
  Size of practice (solo GP, 2–4 GPs, 5+ GPs)
  Location of practice (urban, rural, remote)
- **Patient characteristics**
  Proportion of encounters with male patients
  Proportion of encounters with patients <5 years old
  Proportion of encounters with patients 5–14 years
  Proportion of encounters with patients 15–24 years
  Proportion of encounters with patients 25–44 years
  Proportion of encounters with patients 45–64 years
  (The age group 65+ years was excluded. It is a linear combination of the other groups.)
  Proportion of encounters with new patients
  Proportion of encounters with patients with a health care card or DVA card
- **Problems managed**
  Rate of problems in each of the ICPC-2 chapters
- **Consultation type**
  Proportion of Level A encounters
  Proportion of Level B encounters
  Proportion of Level C encounters
  Proportion of Level D encounters
- **Time (year of the study).**

10.1 Univariate analysis

The proportion of variance in pathology test ordering rates explained by each variable alone was determined using simple linear regression. The results of the univariate analyses are summarised in Table 10.1. Variables that were significant univariate predictors of pathology ordering rates when fitted alone were:

- GP sex, GP age, place of graduation, years in general practice, practice location (both state/territory and rurality), sessions per week and size of practice
- sex of patients, proportion of patients aged less than five years, 5–14 years, 15–24 years and 45–64 years
- management rates of problems (in order of predictive value):
  - related to the female genital system
  - associated with the endocrine and metabolic system
  - related to the blood and blood-forming organs
  - related to the urinary system
  - of a general and unspecified nature

  and to a lesser extent
  - those related to the respiratory, digestive, and circulatory systems, of a social or psychological nature, and those related to skin, male genital system and pregnancy
- the Medicare item level claimed for the encounter
- time (year of study).

Table 10.1: Univariate analysis of pathology ordering over time (1998–2001)

Variable	Regression coefficient	Effect size (standard Beta)	Per cent of variance explained (R–sq*100)	p-value
GP characteristics				
GP sex	—	—	3.7	<0.0001
Female GP (reference = male)	7.63	0.19	—	—
GP age (reference = <35 years)	—	—	3.4	<0.0001
35–44 years	1.02	0.03	—	0.46
45–54 years	–2.94	–0.07	—	0.03
55+ years	–7.58	–0.18	—	<0.0001
Place of graduation (reference = Australia)		—	1.3	<0.0001
New Zealand	–1.31	—	—	0.65
Other	–4.92	—	—	<0.0001
Years in practice (reference = <5 years)	—	—	3.1	<0.0001
5–9 yrs	2.03	—	—	0.17
10–19	0.76	—	—	0.58
20+	–5.39	—	—	<0.0001

(continued)

Table 10.1 (continued): Univariate analysis of pathology ordering over time (1998–2001)

Variable	Regression coefficient	Effect size (Standard Beta)	Per cent of variance explained (R–sq*100)	P–value
Sessions per week (reference = <6)	—	—	0.7	<0.0001
6–10	–0.82	–0.02	—	0.40
11+	–4.81	–0.10	—	<0.0001
Practice characteristics				
Practice size (reference = solo)	—	—	1.4	<0.0001
2–4 GPs	4.34	0.12	—	<0.0001
5+ GPs	6.09	0.16	—	<0.0001
State/territory	—	—	0.5	0.03
Rurality (reference = urban)	—	—	1.1	<0.0001
Rural	4.42	0.10	—	<0.0001
Remote	4.14	0.03	—	0.17
Patient characteristics				
Rate of male patients	–0.25	–0.17	2.8	<0.0001
Rate of patients <5 years	–0.12	0.04	0.2	0.03
Rate of patients 5–14 years	–0.44	–0.11	1.2	<0.0001
Rate of patients 15–24 years	–0.11	–0.04	0.2	0.04
Rate of patients 25–44 years	0.04	0.03	0.1	0.16
Rate of patients 45–64 years	0.18	0.08	0.6	<0.0001
Rate of patients 65 + years	0.01	0.01	0.0	0.75
Rate of new patient	–0.01	0.01	0.0	0.67
Rate of card holders	0.02	0.03	0.0	0.13
Problems managed				
Rate of A chapter (General/unspecified)	0.54	0.22	4.9	<0.0001
Rate of B chapter (Blood/blood-forming)	1.70	0.25	6.1	<0.0001
Rate of D chapter (Digestive)	0.60	0.14	1.9	<0.0001
Rate of F chapter (Eye)	–0.23	–0.02	0.0	0.19
Rate of H chapter (Ear)	0.03	0.00	0.0	0.81
Rate of K chapter (Circulatory)	0.25	0.14	1.2	<0.0001
Rate of L chapter (Musculoskeletal)	0.03	0.01	0.0	0.49
Rate of N chapter (Neurological)	0.16	0.02	0.0	0.21
Rate of P chapter (Psychological)	0.16	0.08	0.6	<0.0001
Rate of R chapter (Respiratory)	–0.29	–0.15	2.3	<0.0001
Rate of S chapter (Skin)	0.20	0.08	0.6	<0.0001
Rate of T chapter (Endocrine, metabolic)	0.80	0.27	7.2	<0.0001
Rate of U chapter (Urinary)	2.16	0.24	5.9	<0.0001
Rate of W chapter (Pregnancy/family plan)	0.55	0.15	2.1	<0.0001

(continued)

Table 10.1 (continued): Univariate analysis of pathology ordering over time (1998– 2001)

Variable	Regression coefficient	Effect size (Standard Beta)	Per cent of variance explained (R–sq*100)	P–value
Rate of X chapter (Female genital)	0.71	0.28	7.6	<0.0001
Rate of Y chapter (Male genital)	0.98	0.12	1.3	<0.0001
Rate of Z chapter (Social)	0.97	0.10	1.0	<0.0001
Medicare item number level	2.89	0.13	1.6	<0.0001
Medicare Level A—Short	–0.06	–0.01	0.0	0.63
Medicare Level B—Standard	–0.10	–0.01	1.2	<0.0001
Medicare Level C—Long	0.50	0.26	6.5	<0.0001
Medicare Level D—Prolonged	0.34	0.08	0.6	<0.0001
Time (year)	2.89	0.13	1.6	<0.0001

Note: Chapter—chapter in the ICPC-2 classification (see methods); shading indicates significant predictors of pathology ordering.

10.2 Multiple regression modelling

Multiple regression was used to find the independent predictors of GP pathology ordering rates. The results are presented in Table 10.2.

When all variables of interest were entered, the full additive model explained 33.4% of the variance in pathology ordering rates ($F_{45,2860} = 31.93$, $p<0.0001$).

The model was reduced using backward elimination with predictor variables fitted in 'families' in the following order, GP demographics, practice characteristics, consultation type, patient demographics, problems managed. The model was reduced by each family in turn, starting with problems managed, adjusting for all other families. Variables within problems managed were kept if significant (alpha=0.05) or improved the fit of the model. The next family of patient demographics was then reduced. The independent effect of year was tested after reducing all other variables in the model.

The independent predictors of GP pathology ordering rates were:

- years in general practice
- size of practice
- place of graduation
- region of practice
- age groups of patients
- rates of problems managed of a general and unspecified nature; related to the blood and blood-forming organs, the endocrine and metabolic system, the ear, the circulatory system, the skin, the urinary system and the female and male genital systems; and associated with pregnancy and family planning
- rates of long consultations and
- year.

After adjusting for all other significant factors, **lower** rates of pathology ordering were associated with:

- GPs who had 20 or more years in general practice
- GPs who had graduated outside Australia or New Zealand.

Table 10.2: Final model of independent predictors of GP imaging order rates

Predictor (explanatory variable)		Regression coefficient[(a)]	T-Value (F-partial)	p-value[(b)]	Effect size (standard Beta)[(c)]	Unique variance (per cent)[(d)]
Years in general practice						0.89
Versus <5 years	5–9 years	0.71	0.57	0.572	0.01	—
	10–19 years	–0.98	–0.84	0.403	–0.02	—
	20+ years	–5.04	–4.25	<0.0001	–0.14	—
Size of practice						0.44
Versus solo	2–4 GPs	2.63	3.17	0.002	0.07	—
	5+ GPs	3.70	4.30	<0.0001	0.10	—
Place of graduation						0.19
Versus Australia	New Zealand	–0.82	–0.34	0.734	–0.01	—
	Other	–1.98	–2.85	0.004	–0.05	—
Region of practice				<0.0001		0.69
Versus urban	Rural	3.66	5.27	<0.0001	0.09	0.66
	Remote	4.40	1.74	0.083	0.03	0.07
Patient age						
Rate of patients 15–24 years		0.22	3.91	<0.0001	0.07	0.36
Rate of patients 25–44 years		0.08	2.32	0.021	0.05	0.13
Rate of patients 45–64 years		0.18	4.32	<0.0001	0.08	0.43
Problems managed						
Rate of A chapter (General/unspecified)		0.27	6.52	<0.0001	0.11	1.01
Rate of B chapter (Blood/blood-forming)		1.27	11.52	<0.0001	0.18	3.13
Rate of H chapter (Ear)		0.26	2.49	0.013	0.04	0.15
Rate of K chapter (Circulatory)		0.20	4.73	<0.0001	0.11	0.53
Rate of S chapter (Skin)		0.16	4.01	<0.0001	0.06	0.38
Rate of T chapter (Endocrine, metabolic)		0.58	10.06	<0.0001	0.19	2.39
Rate of U chapter (Urinary)		1.27	8.87	<0.0001	0.14	1.86
Rate of W chapter (Pregnancy/family plan)		0.25	3.36	0.001	0.07	0.27
Rate of X chapter (Female genital)		0.29	5.85	<0.0001	0.11	0.81
Rate of Y chapter (Male genital)		0.99	7.30	<0.0001	0.12	1.26
Proportion of Medicare Level C – Long		0.20	6.07	<0.0001	0.10	0.87
Time		2.23	6.22	<0.0001	0.10	0.91

(a) Unit change in pathology rate for every unit change in the variable. Units are original measurement units. Negative values represent a reduction in pathology rates with an increasing rate of the predictor.

(b) Significance when all other variables in the model are held constant.

(c) The standardised effect of the variable on pathology rates. Measured as standard deviation change in pathology rate for every standard deviation change in the explanatory variable.

(d) The per cent of variance in pathology rates explained uniquely by the variable after taking into account the variance explained by all other variables in the model.

Higher ordering rates were associated with:

- larger practices
- rural and remote practices
- higher proportions of working-age adult (aged between 15–64) patients
- higher management rates of problems associated with the blood and blood-forming organs, the endocrine and metabolic system, the circulatory system, pregnancy and family planning, and urinogenital problems
- higher rates of Medicare Level C (long) consultations.

However, after adjusting for all other significant independent predictors, pathology orders were found to have increased significantly over time. That is, independent of the effect of the variables listed above, pathology ordering rates increased with time.

The final model explained 31.9% of the variance in pathology ordering ($F_{23,2881} = 56.2$, $p<0.0001$). The strongest independent predictors of pathology ordering rates (those with the largest effect sizes) were the rates of management of problems related to the blood and blood-forming organs and the rates of endocrine and metabolic problems. These explained 3.1% and 2.4% of the variance in pathology rates respectively (Table 10.2).

11 Discussion

The average number of pathology tests ordered by GPs participating in BEACH between 1998–99 and 2000–01 increased from 24.6 per 100 encounters to 29.4 per 100, and from 17.8 to 20.9 per 100 problems managed.

This increase (19.5%) reflects but exceeds the increase in the total number of claims for pathology tests through the MBS (12%) over the same period. Chemical pathology in particular reflected this discrepancy. The MBS data showed an increase of 22.6% in pathology tests of this type but the BEACH data demonstrated an increase of 36% in GP test orders. In parallel, the number of Microbiology tests claimed increased by 5.5% but the BEACH data showed that GPs had an 9.8% increase in the rate of orders for these test types from year 1 to year 3 of the study. These differences are likely to reflect the effect of coning on the MBS claims data. It is probable that the increases in the ordering of multiple tests revealed in this study are not reflected in the claims made by pathologists because of the limit of three items claimed under the coning system. Some overall differences in GPs' pathology orders and pathologist claims will also occur as a result of bundling multiple orders into one MBS item for the purpose of claiming. It is likely that this effect explains some of the difference in rates of change in the MBS and the BEACH data, since bundling a larger number of tests would not increase the number of items claimed although it may change the item number itself.

Changes in the number and type of tests ordered

For total pathology orders there was no change in the likelihood of the GP ordering any pathology at the encounter or for the problem under management. After removal of the Pap smears there was a slight (and significant) increase in the likelihood of their ordering pathology for the problem under management. However, the real change was in the number of tests ordered after the decision to order pathology was made. There was a significant move away from single test ordering to multiple tests, and a significant increase in the number of problems for which 3, 4 or 5 tests were ordered. In reality there may also be a move towards 6 or more tests but the limit of five tests on the recording form provides us with no indication of the extent to which GPs order 6 or more tests from the pathologist. It must also be remembered that multiple test orders may include one or more batteries of tests such as full blood count so that the actual number of tests undertaken by the pathologist could be many more than the four or five maximum allowed on the BEACH recording form. However, the bundling of some haematology and chemistry tests into composite MBS items may cause an opposite effect.

The major change in ordering rates of individual tests or batteries of tests was demonstrated between 1999–00 and 2000–01. In particular, between these two years orders for full blood counts increased from 3.4 to 3.8 per 100 encounters, those for lipid tests increased from 2.3 to 3.3 per 100 encounters, while glucose tests increased from 1.4 to 2.1 per 100 encounters. These increases may seem relatively small but an increase of one test per 100 encounters represents an increase of about 1 million test orders across the country over a year. This means that the increase in lipid tests, full blood counts and glucose tests together accounted for an additional 2.1 million test orders in 2000–01 compared with 1999–00.

The increase in orders for multibiochemical testing came between 1998–99 and1999–00 (from 0.4 to 1.1 per 100 encounters) and then remained steady (1.2).

Such sudden increases in rates of specific types of tests require consideration of any changes that may have occurred in the pattern of problems managed over the period of the study, particularly in the ordering and management rates of the more commonly tested problems.

Pathology tests rates for specific morbidity

There were four problems that showed significant increases in pathology ordering rates in descriptive analysis. The test rate for hypertension had almost doubled over the study years (from 11.1 to 20.4 tests per 100 problem contacts) but the increase was steady over time. Test rates for menopausal problems also increased steadily (from 17.5 to 28.2 per 100 encounters). However, those for ischaemic heart disease and diabetes showed a relatively sudden increase between 1999–00 and 2000–01 rather than a steady increase over time. The increase in pathology testing for ischaemic heart disease (from 23.0 per 100 encounters in 1999–00 to 33.1 in 2000–01) may reflect the change in the Pharmaceutical Benefits Scheme guidelines for the preventive care of certain at-risk patients by provision of pharmacological treatment with lipid lowering agents. This change occurred in mid-1999. It is likely that by 2000–01 more patients with (e.g.) ischaemic heart disease (but without lipid problems) had been put on lipid lowering agents in response to the change in the guidelines. In turn this is likely to result in continuing pathology tests for these patients over time.[23]

Test rates for diabetes also leapt between 1999–00 and 2000–01, rather than increasing steadily in each year (47.5 in 1998–99 and 44.0 in 1999–00 but 60.1 in 2000–01). This may well be related to the introduction (in August 1999) of the Cardiab database which incorporates registration of patients with diabetes on a Divisional basis.[24]

Multiple regression modelling demonstrated significant increases in the pathology test ordering rates for other problems, including lipid disorders, thyroid problems and weakness/tiredness. However, these increases reflected the overall increase in pathology ordering rates. In contrast the increases in test rates for blood pressure problems, other cardiovascular morbidity (excluding blood pressure problems, heart failure and ischaemic heart disease) and diabetes were significantly greater than the average for all problems.

It was thought that this could be due to increased management rates of these problems between 1998–99 and 2000–01. If management rates had increased then this may explain the increase in test ordering rates. However, the study showed that there had been no significant increase in the management rate of blood pressure problems, weakness/tiredness and thyroid problems, and there had actually been a decrease in the management rate of other cardiovascular problems. The increases in test ordering rates for these problems can therefore only be described as reflecting the overall increase in test ordering rates, but not be explained by increased management rates. However, the effect of the increase in pathology ordering rates per tested hypertension problem added an estimated extra 950,000 tests per year to the total GP pathology orders in Australia.

In contrast, the management rates of diabetes and lipid disorders increased significantly over the period of the study. This means that for these two problems there was an additive effect on pathology test ordering rates—both an increase in the management rate and an above average increase in the number of tests ordered for these problems. Investigation of the size of this additive effect and extrapolation to all of general practice showed that in 2000–01 GPs

would have ordered an additional 0.5 million pathology tests for the management of lipid problems and an additional 0.5 million for the management of diabetes, compared with 1998–99 (Section 7.1).

The increased management rate of lipid disorders has been shown in previous research to be due to a steady annual increase in the number of people identified as having high cholesterol and being put on lipid lowering agents, added to the steady long term management of those already identified.[6] With an increase of 0.32 people identified per 100 encounters each year,[8] the increase in pathology ordering for lipid problems is likely to continue. In the case of diabetes, GPs are being encouraged to better identify the disease as it is thought to be under-diagnosed in the community. Further, the introduction of a specific MBS item number for a series of consultations for diabetes may generate further increases in pathology test orders for this problem as these items require a minimum of four pathology tests to be performed each year for each patient with diabetes.[25]

Changes in characteristics of GPs

Previous research had shown a relationship between pathology ordering rates and characteristics of the GP.[26] It was therefore hypothesised that measured increases in pathology test ordering rates over the study period may be explained either partially or fully by changes in the characteristics of the GPs who participated. The question then arose as to whether any changes in these characteristics reflected similar changes in the total active GP population or were merely a result of sampling error.

The results demonstrated that the characteristics of the BEACH participating sample had changed between 1998–99 and 2000–01. In 2000–01 participants were older, more likely to be in solo practice and more likely to have graduated overseas. However, the representativeness of the annual BEACH sample is always considered. Comparison of the characteristics of participants with those of the total GP sample frame is made annually and post-stratification weighting is applied to correct for any differences in the characteristics of the two groups (see Methods). Post-stratification weighting ensures that the final encounter data set is representative of all GPs. After weighting is applied to the GP participant sample any changes that remain can be said to reflect a true change in the characteristics of the total GP population. These results demonstrated that in 2000–01 GPs practising in Australia were significantly more likely to have graduated outside Australia than in 1998–99. Though there was a significant difference in state/territory distribution there was no clear pattern of change apparent. The total GP population had not aged over the period of the study and the sex distribution was also not different between 1998–99 and 2000–01, either in the GP participating sample or in the estimated total population. This is important because previous research has shown a strong relationship between GP sex and ordering patterns, women ordering significantly more tests than men. A change in sex distribution could therefore have been a potential explanation of the increases in pathology ordering. The change in practice size became marginal after adjustment and it is unlikely that this factor was influential in the total practising GP population.

The relationships demonstrated in this study between GP characteristics and pathology test ordering rates supported the earlier research.[1] Female GPs, GPs aged less than 45 years, those in larger practices, and those working in rural areas all demonstrated significantly higher pathology ordering rates than their counterparts. The difference between male and female GPs was considerable even though Pap smears had been removed from this analysis, probably reflecting the fact that females see more women and manage more genito-urinary problems in both sexes than their male counterparts.

It is interesting to find that once the decision was made to order pathology for a problem under management there was relative consistency in the average number of tests ordered for each GP characteristic, with the exception of GP age. This suggests that the differences in ordering rates (noted above) result from a higher number of tested problems for GPs who are female, those in larger practices and those in rural areas. The higher ordering rates of female practitioners probably relates to the previously described differences in practice styles of these practitioners.[1,26] Issues of access to facilities and specialist advice in rural areas may also provide a logical explanation for higher ordering in these regions. The higher ordering rates in large practices, although also noted in the 1999 study,[1] are more difficult to explain and may merit further investigation.

In contrast, once the decision was made to test the problem there was a steady inverse relationship between GP age and the number of tests ordered. GPs of less than 35 years ordered on average 206 tests per 100 tested problems and those of 55 years or more ordered 180 per 100 tested problems. This behavioural difference could reflect some uncertainty in younger GPs regarding their diagnostic and management prowess and increasing assurance with age and experience in these areas. It may also reflect differences in training. A large proportion of the younger GPs would have been through the GP training program, made mandatory in 1989 as the only path to professional recognition, while only a small proportion of older GPs would have been through specialist GP training. In addition, the Training program of the 1990s has been very different from earlier programs, which were less formalised and were voluntary in nature. It is also possible that more recently trained GPs have a more thorough and up-to-date knowledge of available guidelines for the care of patients with specific diseases that reflects in higher ordering rates than their older GP counterparts. However, ordering rates may also be influenced by undergraduate and early hospital training of junior doctors in teaching hospitals which tend to promote exhaustive investigation and a poor tolerance of diagnostic uncertainty. Older GPs may learn by experience that the low incidence of serious disease in general practice patients compromises the sensitivity and specificity of many pathology tests, rendering them less useful.

One of the difficulties in interpreting these data is that there are no sound benchmarks of what is 'good quality' in terms of the number and type of pathology tests to be ordered. It is therefore not possible to say whether higher or lower test-ordering rates reflect better quality care. However, the objective was to measure the extent to which changes in GP characteristics over time contributed to the increase in pathology ordering rates. While it has been shown that some GP characteristics are significantly associated with rates of pathology test orders, since there has been no change in the characteristics of the total practising GP population this relationship cannot have caused the measured increase in pathology test ordering rates.

Pathology and its relationship to other management

It was thought possible that increases in pathology test ordering rates (and therefore increased costs to the MBS for these services) may be countered by related decreases in other management such as prescriptions, therapeutic procedures and imaging test orders.

There was a significant inverse relationship between pathology test ordering rates and prescribing—the more the pathology the less medications prescribed. However, because pathology is ordered for a relatively small proportion of problems and medications are prescribed for a relatively large proportion, the increased pathology ordering rate was not associated with a significant decrease in prescribing rates. Time remained an independent predictor of pathology ordering rates after adjustment for prescription rates.

There was a significant linear relationship between imaging orders and pathology orders. And total imaging order rates did increase over the period of the study. However, the proportion of problems for which either type of test is ordered is relatively small in the totality of general practice. Time remained an independent predictor of pathology ordering rates after adjustment for imaging rates so it is unlikely that the increase in pathology tests had any significant impact on imaging rates over time.

It was interesting to find a strong relationship between a single pathology test order and the undertaking of a therapeutic procedure. This is not surprising as the most common therapeutic procedure undertaken in general practice is excision/biopsy, and excision of a lesion usually requires that it undergo histological examination.

The extent to which the increase in pathology test orders may be related to the diagnostic process, rather than monitoring of ongoing problems, or for the purposes of preventive care was investigated. The increase in the rate of pathology tests classed as *diagnostic pathology* (26%) and *preventive care pathology* (26%) between 1998–99 and 2000–00 generally reflected the overall increase for all pathology (22%). However, the increase in *monitoring pathology* was lower than average at 13%, while the increase in *other pathology* was almost double the average, at 41%. Tests classed as *other pathology* are those attached to a problem labelled in terms of the process of care (such as 'blood test', 'check-up') rather than in terms of the problem(s) under management. This probably reflects an increasing tendency for GPs to record the problem label in terms of the process of care and this may reflect a number of factors. Where the GP is managing a patient with a complex set of chronic problems the term 'check-up' may cover an overall management of the patient without specific attention to each of the problems the patients has. In addition there are (since the broadening of the guidelines for lipid lowering agents to include at-risk patients) an increasing number or patients who do not have high cholesterol but for whom lipid-lowering agents are prescribed for preventive purposes. When monitoring the pathological effect of the medication the GP may be faced with difficulties in deciding on a problem label (which would in other cases, be hypercholesterolemia or lipid problem). Rather than identify the underlying morbidity regarded as the problem under management (such as ischaemic heart disease) the GP chooses to simply record 'blood test'. These issues are discussed in more detail in Section 6.3.

Clearly there are many factors which have contributed to the measured increase in pathology test ordering rates by GPs over the period of this study. Multiple regression was used to ascertain the significant predictors of pathology test ordering. This analysis does not attempt to predict the reasons for the increased order rates but, rather, investigates which factors are the strongest predictor of these rates. The final predictive model accounted for more than 30% of the variance in GP pathology test rates. This is a very strong result. Few models predict such a large proportion of variance. The strongest predictors of pathology test ordering were the rates of management of some problem types, particularly those associated with the blood and blood-forming organs and those related to the endocrine and metabolic system (most likely to be diabetes and lipid problems). Other predictors of high ordering rate included GPs in larger practices, practising in rural and remote areas, higher proportions of working age patients (15–64 years) and high rates of management of circulatory disease, urinary problems, and pregnancy and family planning, together with high rates of Medicare Level C consultations.

However, independent of all these factors, time itself remained a significant predictor of pathology ordering rates. The major factor contributing to the measured increase in pathology test orders by GPs appears to be the increase in the number of tests ordered per episode rather than any major increase in the proportion of problems that are tested. The cause of this move to more tests per episode can only be hypothesised. Irrespective of the demonstrated relationship between pathology ordering and GP characteristics, and between test orders and selected pathology there has been an independent increase in pathology ordering rates that cannot be explained by any of the factors for which data were available in this study.

Other factors which may have been influential in altering the pattern of ordering include changes to guidelines, particularly those for management and secondary prevention of diabetes and cardiovascular disease, which promote more intensive monitoring of patients. It could also be speculated that a move to computerised ordering of pathology may lead to pre-programmed batteries of tests, a problem identified with paper order forms before their content was regulated.[3] The effect of the medical indemnity 'crisis' may also be a factor by increasing 'defensive' ordering.

The increasing emphasis on management of chronic disease in the community, and on secondary and tertiary prevention could be expected to lead to continuing increases in pathology ordering by GPs. Increasing computerisation of pathology ordering could also contribute to increased orders, through ease of selection of multiple tests and/or through use of decision support systems.

12 Conclusion

There has been a significant increase in pathology test ordering rates by GPs between 1998–99 and 2000–01. There has been a relatively small increase in the proportion of problems for which pathology is ordered but there has been a move away from ordering a single test per problem to ordering three or more tests per episode. The major increase has been in orders for Chemical pathology followed by Haematology, with a smaller but significant increase in Histopathology. The increases are reflected in pathology ordered for all purposes, particularly for diagnostic and preventive care and other pathology, and to a lesser extent in monitoring pathology.

While order rates are significantly related to GP characteristics, there was no apparent change in the characteristics of practising GPs so this relationship is unlikely to be the cause of increased pathology test orders. Some of the increase can be explained by increased management rates of a few common conditions. However, the majority of the measured increase cannot be explained by factors measured in this study. External influences such as changes in guidelines for chronic diseases, system changes such as increased computerisation and possibly increased fear of litigation must be considered as possible influences on pathology ordering rates of GPs over the period of this study.

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Glossary

A1 Medicare items: Medicare item numbers 1, 2, 3, 4, 13, 19, 20, 23, 24, 25, 33, 35, 36, 37, 38, 40, 43, 44, 47, 48, 50, 51, 601, 602, 720, 722, 724, 726, 728, 730, 734, 738, 740, 742, 744, 746, 749, 757, 759, 762, 765, 768, 771, 773, 775, 778, 779, 801, 803, 805, 807, 809, 811, 813, 815.

- *Medicare Level A items:* Medicare item numbers 3, 4, 13, 19, 20.
- *Medicare Level B items:* Medicare item numbers 23, 24, 25, 33, 35.
- *Medicare Level C items:* Medicare item numbers 36, 37, 38, 40, 43.
- *Medicare Level D items:* Medicare item numbers 44, 47, 48, 50, 51.

Activity level: The number of general practice A1 Medicare items claimed during the previous 3 months by a participating general practitioner.

Consultation: See *Encounter*

Diagnosis/problem: A statement of the provider's understanding of a health problem presented by a patient, family or community. GPs are instructed to record at the most specific level possible from the information available at the time. It may be limited to the level of symptoms.

- *New problem:* The first presentation of a problem, including the first presentation of a recurrence of a previously resolved problem but excluding the presentation of a problem first assessed by another provider.
- *Old problem:* A previously assessed problem that requires ongoing care. Includes follow-up for a problem or an initial presentation of a problem previously assessed by another provider.

Pathology class: A class to which a pathology tests type in BEACH is allocated through its relationship with the type of problem for which the test was ordered.

- *Diagnostic pathology*: All pathology test orders associated with problems classified in ICPC-2 Component 1 (Symptoms and complaints), all infections (from Component 7) and all misadventure codes.
- *Monitoring pathology:* All pathology test orders associated with all morbidity classified in Component 7 of ICPC-2, except for infections and misadventure**.**
- *Preventive care pathology:* All pathology test associated with problem labels which described a check–up, whether partial or full.
- *Other pathology:* All pathology tests associated with problem labels which described service provisions (including specified pathology tests, advice and health education, medication renewals, referrals, other services).

Encounter (enc): Any professional interchange between a patient and a GP.

General practitioner (GP): A medical practitioner who provides primary comprehensive and continuing care to patients and their families within the community (Royal Australian College of General Practitioners).

Health Care Card holder: A person who holds a Health Care Card from the Commonwealth Government which allows the holder prescription medicines for themselves and their dependants at greatly reduced cost and free after a cost threshold is reached.

Morbidity: Any departure, subjective or objective, from a state of physiological wellbeing. In this sense, sickness, illness and morbid conditions are synonymous.

Pathology encounters: Those encounters at which at least one pathology test (or battery of tests) (other than a Pap smear) was ordered.

Problem managed: See *Diagnosis/problem*.

Provider: A person to whom a patient has access when contacting the health care system.

Reasons for encounter: The subjective reasons given by the patient for seeing or contacting the general practitioner. These can be expressed in terms of symptoms, diagnoses or the need for a service.

Recognised GP: A medical practitioner who is vocationally recognised under Section 3F of the Health Insurance Act, ***or***

- who is a holder of the Fellowship of the Royal Australian College of General Practitioners who participates in, and meets the requirements for, quality assurance and continuing medical education as defined in the RACGP Quality Assurance and Continuing Medical Education Program, ***or***
- who is undertaking an approved placement in general practice as part of a training program for general practice leading to the award of the Fellowship of the Royal Australian College of General Practitioners or undertaking an approved placement in general practice as part of some other training program recognised by the RACGP as being of equivalent standard. (Medicare Benefits Schedule book, 1 November 1998).

Referral: The process by which the responsibility for part or all of the care of a patient is temporarily transferred to another health care provider. Only new referrals to specialist, allied health professionals, and for hospital and nursing home admissions arising at a recorded encounter are included. Continuation referrals are not included. Multiple referrals can be recorded at any one encounter.

Rubric: The title of an individual code in ICPC-2 PLUS.

Practice location: The location of the main practice address according to its postcode, defined by the Rural Remote and Metropolitan Area classification and by state or territory.

- *Rural practices:* Those practices in Categories 3, 4, 5, 6 and 7 in the Rural, Remote and Metropolitan Area classification.
- *Urban practices:* Those practices in Categories 1 and 2 of the Rural, Remote and Metropolitan classification

Tested problems: those problems managed at the encounter that generated at least one order for pathology.

Veterans' Affairs card holder: a person who hold a health card from the Commonwealth Department of Veterans' Affairs.

Abbreviations

AMTS	Australian Morbidity and Treatment Survey 1990–91
BEACH	Bettering the Evaluation And Care of Health
CI	Confidence interval (in this report 95% CI is used)
DVA	Commonwealth Department of Veterans' Affairs
Enc	Encounter
ESR	Erythrocyte sedimentation rate
EUC	Electrolytes, urea and creatinine
FRACGP	Fellow of the Royal Australian College of General Practitioners
GP	General practitioner
HbA1c	Haemoglobin, type A1c
HIC	Health Insurance Commission
HIV	Human immunodeficiency virus
ICPC	International Classification of Primary Care
ICPC-2	International Classification of Primary Care (2nd edition)
ICPC-2 PLUS	An extended vocabulary of terms classified according to ICPC-2
MBS	Medicare Benefits Schedule
MC&S	Microscopy, culture and sensitivity
NEC	Not elsewhere classified
NOS	Not otherwise specified
RACGP	Royal Australian College of General Practitioners
SAND	Supplementary Analysis of Nominated Data
SAS	Statistical Analysis System
UTI	Urinary tract infection

Appendices

Appendix 1: Example of a recording form (1998–99)

BEACH (Bettering the Evaluation And Care of Health) -Morbidity and Treatment Survey -National National

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DOCID:

Date of encounter	Date of Birth	Sex	Patient status	Patient Postcode
___/___/___	___/___/___	M ☐ F ☐	New ☐ Old ☐	

NESB?	Aboriginal?	Torres Strait Islander?
Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐

Encounter Number:

Patient Reasons for Encounter (up to three)	HCC Status	Veterans Affairs
1.	Yes ☐ No ☐	Gold card ☐ White card ☐
2.		
3.		

PATIENT SEEN
Item no. ____
W/C paid ☐
Other paid ☐
No charge ☐

PATIENT NOT SEEN
Script..... ☐
Referral..... ☐
Certificate..... ☐
Other..... ☐

1. Diagnosis/problem	Work Related ☐	**Problem status** New ☐ Old ☐						
Medications for this problem: (up to four)	Strength	Regimen	No. Rpts	? OTC	GP Supply	Drug status New	Drug status Cont.
1.							
2.							
3.							
4.							
Procedures, other treatment, counselling		New referrals, admissions					

2. Diagnosis/problem	Work Related ☐	**Problem status** New ☐ Old ☐						
Medications for this problem: (up to four)	Strength	Regimen	No. Rpts	? OTC	GP Supply	Drug status New	Drug status Cont.
1.							
2.							
3.							
4.							
Procedures, other treatment, counselling		New referrals, admissions					

3. Diagnosis/problem	Work Related ☐	**Problem status** New ☐ Old ☐						
Medications for this problem: (up to four)	Strength	Regimen	No. Rpts	? OTC	GP Supply	Drug status New	Drug status Cont.
1.							
2.							
3.							
4.							
Procedures, other treatment, counselling		New referrals, admissions					

4. Diagnosis/problem	Work Related ☐	**Problem status** New ☐ Old ☐						
Medications for this problem: (up to four)	Strength	Regimen	No. Rpts	? OTC	GP Supply	Drug status New	Drug status Cont.
1.							
2.							
3.							
4.							
Procedures, other treatment, counselling		New referrals, admissions					

Pathology	**for problem(s)**
1	1 2 3 4
2	1 2 3 4
3	1 2 3 4
4	1 2 3 4
5	1 2 3 4

Test/Body Site for problem(s)	
Plain X-ray	1 2 3 4
.....	
US/CT/Contrast	1 2 3 4
.....	
Other Imaging	1 2 3 4
.....	

To the patient:
In general would you say your health is:
Excellent..... ☐
Very good... ☐
Good..... ☐
Fair..... ☐
Poor..... ☐

Patient's
Height: ____ cm
Weight: ____ kg

To the patient if 18+:
How often do you have a drink containing alcohol?
Never ☐
Monthly ☐
Once a week ☐
2-4 times a week ☐
5+ times a week ☐

How many standard drinks do you have on a typical day when you are drinking? ____

How often do you have 6 or more standard drinks on one occasion?
Never..... ☐
Monthly or less..... ☐
Once a week..... ☐
2-4 times a week... ☐
5+ times a week.... ☐

BOIA

Appendix 2: GP characteristics questionnaire (1998–99)

The University of Sydney
at Westmead Hospital

General Practice Statistics and Classification Unit
Family Medicine Research Centre
Department of General Practice

a collaborating unit of the
Australian Institute of Health and Welfare

AIHW

Please fill in boxes or circle answers where appropriate

1. Doctor Identification Number: [ ][ ][ ][ ]

2. Sex: Male / Female 3. Age [ ]

4. How many years have you spent in general practice? [ ]

5. Number of general practice sessions you usually work per week? [ ]

6. How many **full-time** (>5 sessions per week) general practitioners work with you at this practice? (Practice= shared medical records) [ ]

7. How many **part-time** (<6 sessions per week) general practitioners work with you at this practice? (Practice= shared medical records) [ ]

8. Do you conduct more than **50%** of consultations in a language other than English? Yes / No

9. What is the postcode of your major practice address? [ ][ ][ ][ ]

10. Country of graduation: Aust NZ Asia UK Other: _____

11. General Practice training status (CSCT or RACGP training programme)?	Presently training	Completed training	Not applicable

12. Do you hold FRACGP? Yes / No

13. Are you a member of any of the following organisations? AMA RACGP RDAA

14. How do you routinely instruct pharmacists on the substitution of generic drugs?	No substitute allowed	Substitute allowed

15. Special interests: *(up to three)*

1. Acupuncture	7. Dermatology	13. Paediatrics
2. Anaesthetics	8. Diabetes	14. Preventive medicine
3. Asthma	9. Geriatrics/aged care	15. Psychiatry
4. Cardiology	10. Nutrition	16. Sports medicine
5. Computers	11. Obstetrics/antenatal	17. Surgery
6. Counselling	12. Occup./indust.med.	18. Women's Health

Other _____

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Appendix 3: Code groups from ICPC-2 and ICPC-2 PLUS used in this report

Problem or code group label	ICPC-2 codes
Component 1	—(1–29 inclusive)
Components 2–6	—(30–69 inclusive)
Component 7	—(70–99 inclusive)
Diagnostic pathology	—(01–29 inclusive) + —(70–99 inclusive) except the infection codes A70, A71, A72, A73, A74, A75, A76, A77, B70, B71, D70, D71, D73, D88, D96, F70, F72, F73, F86, H70, H71, H72, H74, B90, D72, U72, X70, X71, X73, X74, X90, X91, X92, Y03, Y70, Y71, Y72, Y73, Y76, R72, R73, R74, R71, R78, R79, R80, R81, R82, S03, S09, S10, S70, S71, S72, S73, S75, S84, S85, S95, S96, S11, S74, S76, U70, U71, X72, X84, Y75, Y74, K70, K71, R83, T70, W70, W71, W94, L70, N70, N71, N72, N73 and the misadventure codes A80, A81, A84, A85, A86, A87, A88, A89, B76, B77, D79, D80, F75, F76, F79, H76, H77, H78, H79, H85, L72, L73, L74, L75, L76, L77, L78, L79, L80, L81, L96, P77, N79, N80, N81, R87, R88, S12, S13, S14, S15, S16, S17, S18, S19, U80, W75, X82, Y80)
Arthritis NOS (excluding osteoarthritis and rheumatoid arthritis)	L70 009, L70 010, L81 010,L83 010, L84 003, L84 023, L84 024, L84 025, L84 026,L89 004, L90 004, L91 009, L91 010, L91 011, L91 012, L91 013, L92 006, S91 022, T99 063
Blood pressure problems	K85, K86, K87, W81, K88
Check-up	—30, —31
Check-up—General	A30, A31
Check-up—Cardiovascular	K30, K31
Diabetes	T89, T90, W85
Depression	P03, P76
Gastroenteritis, presumed infectious	D73
Hypertension	K86, K87, W81 003
Ischaemic heart disease	K74, K75, K76
Lipid disorder	T93
Malignant skin neoplasms	S77
Menopausal symptoms /complaints	X11
Menstrual problems	X02, X03, X05, X06, X07, X08, X09, X10
Other cardiovascular problems	K01, K02, K03, K04, K05, K06, K07, K22, K28, K29, K73, K81, K82, K84, K95, K96, K99
Pre-postnatal check	W30, W31
Pregnancy	W01, W78, W79, W80, W84
Thyroid problems	T85, T86, T81
Urinary tract infection	U71
Weakness/Tiredness	A04

Note: — All codes starting with a dash can be equally applied to any chapter (with the exception of the Social chapter) so that each of these codes includes 16 possible ICPC-2 codes