

# **The effect of computerisation on the quality of care in Australian general practice**

***A comparative study of practice patterns of GPs who use computers for clinical activity and of those who do not.***

**A secondary analysis of *BEACH***

***Bettering the Evaluation and Care of Health***

## **Final Report to the Royal Australian College of General Practitioners**

*A project funded by a General Practice  
Computing Group Informatics Scholarship*



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## **Authorship**

Joan Henderson asserts her moral right to be recognised as the author of this report.

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## **Summary**

### ***Introduction***

Through the 1990's there was a concerted drive towards computerisation for general practice in Australia. Federal Government initiatives, combined with those of some state and territory health departments and various groups within the profession, have resulted in a dramatic increase in the uptake of computer use by general practitioners (GPs) in recent years. While over 90% of practices have computers available, there is little evidence of how well the technology is being utilised by individual GPs in assisting with clinical activity. The move to computerise general practice over the past three decades seems to have advanced from an underlying premise that the use of a computer will improve various aspects of management and care. There is a general theme among the literature of that period that using a computer will 'improve' the management of health information by facilitating the provision of information needed to assess performance of individual practitioners, to evaluate programs, to monitor patient disease and risk management, and to provide data for research. However, there is little hard evidence that the general use of computers improves efficiency at individual practice level, and a paucity of studies researching the impact of computers on patient outcomes and the quality of care provided by the clinicians who use them. There has also been some controversy over the potential influence of embedded pharmaceutical advertising in clinical software, but there has been no evidence to date to determine whether advertisements displayed via this medium influence the prescribing behaviour of the GPs exposed to it.

### ***Aims***

To investigate the access GPs have to computers at their major practice address, and the extent to which individual GPs report using their computer for a range of clinical purposes; to examine whether GPs who use a computer in their clinical activity differ in their practice behaviour compared to GPs who do not use a computer for clinical purposes; to examine whether GPs who use a computer for clinical purposes differ from their non-computerised counterparts on a range of quality indicators applicable to general practice outcomes; to compare the prescribing behaviour of GPs who use advertising embedded clinical software with those not exposed to advertising via this medium to determine whether this advertising influences the way GPs prescribe.

### ***Methods***

This study is a secondary analysis of data of GPs who participated in the *BEACH* (Bettering the Evaluation and Care of Health) program between October 2003 and March 2005. *BEACH* is a continuous national study of general practice activity, in which each of a random sample of approximately 1,000 recognised GPs per year, records details about 100 doctor-patient contacts of all types on structured paper encounter forms. For this comparative study, GPs were divided into two groups according to their use of a computer for clinical activity to investigate the first three aims, and into two groups according to their use of advertisement embedded clinical software to investigate the fourth aim. A follow-up questionnaire was designed and sent to GPs who had indicated using the medical record function of their clinical software to determine how comprehensively patient information was being stored in an electronic format. Descriptive analyses were first undertaken to describe the true differences between the two groups over a range of measures including the characteristics of the GPs themselves, their practices, the patients they encountered, the problems they

managed, and the managements they provided. Step-wise adjustment for confounding variables was then made using logistic regression and multiple regression to assess the extent to which identified differences were explained by other factors, or could be said to be due to computer use.

A set of 36 quality indicators validated in a previous study of BEACH data for the RACGP was used to compare the practice behaviour of GPs using a computer for clinical purposes with that of those who do not. As the inference from many authors reviewed for this project is that the use of computers will improve health outcomes, the overall hypothesis is that clinical computer users will provide a better standard of care. The individual hypotheses and rationale for each of the domains of care were also based on this assumption. Eight of these indicators, which were applicable to test ordering, were used to compare the GPs who used the computer to order pathology and/or imaging tests with GPs who did not use the computer for this function. To investigate the effect of advertisements embedded in clinical software, the two GP groups were first compared using multiple regression to determine whether there were any GP characteristics independently associated with use of advertising software. Their prescribing behaviour, both before and after adjustment for these predictors was then compared for each of seven advertised products. Prescriptions for the advertised product as a proportion of prescriptions for all products in the same ATC class or group were compared between the GP groups using logistic regression. Anatomical Therapeutic Chemical (ATC) codes for the seven products were identified for analytical purposes. Finally, the seven brands were grouped together and the GP groups were compared using linear regression to determine if the greater statistical power of the combined data would detect a different overall effect.

## **Results**

Of the 1,336 participants, 1,319 GPs responded about the availability of computers at their practice; 1,240 responded about their individual use of a computer; 687 returned medical record follow-up questionnaires (of the 872 who had been sent them); 1,222 responded about the brand of software they use.

### **GP COMPUTER USE**

One in ten GPs (11.2%) did not use a computer at all for any purpose either because they did not have one available at their practice (6.0%) or because they chose not to use one that is available (5.2%). The main clinical functions used were prescribing (83.8%), test ordering (72.7%), keeping some or all patient information medical records (70.3%), internet (59.0%) and email (52.6%). Just over one third of GPs (37.1%) used the computer for all five functions. Half of the GPs (52.1%) who returned a medical record follow-up questionnaire were fully computerized and the remainder used a hybrid system of paper and electronic records for patient information. Only 21.3% of the 1,097 GPs who use computers and clinical software make use of all clinical functions available in their software and store all patient information electronically.

### **Descriptive analyses**

#### **Characteristics of clinical computer users and non-clinical computer users**

When compared with non-clinical computer users, clinical computer users were younger, had significantly fewer years in general practice, were more likely to have graduated from their primary medical degree within the past 20 years, and to have done so in Australia. A greater proportion were female. They were twice as likely to be Fellows of the Royal Australian College of General Practitioners (RACGP); half as likely to bulkbill for all their patients; significantly more likely to work in a practice of 5 or more GPs; significantly less likely to

work in a solo practice, or to work in a major city or metropolitan area. They were twice as likely to work in an accredited practice, and three times more likely to have a practice nurse at the major practice address.

### **Characteristics of encounters**

There were 106,900 encounters with clinical computer users and 18,800 with non-clinical computer users. The only difference between the two groups in the distribution of services emerged in home visits – clinical computer users provided significantly fewer of these. Regarding the content of the encounters, clinical computer users had a significantly higher rate per 100 encounters of problems managed and of pathology tests ordered, and a significantly lower prescribed medication rate.

### **Characteristics of patients at the encounters**

Patients encountered by clinical computer users were more likely to be female and younger. A significantly lower proportion were holders of a Commonwealth Health Care Benefits card and fewer were from a non-English speaking background compared to those encountered by non-clinical computer users. There was no significant difference in the number of patient reasons for encounter recorded between the two groups, although patients at encounters with clinical computer users described significantly more reasons for the encounter that were of a general or unspecified nature, or associated with the female genital system, and significantly fewer problems associated with the circulatory system per 100 encounters.

### **Problems managed at the encounter**

Encounters with clinical computer users involved significantly more problems that were of a general or unspecified nature; were related to the female genital system; or related to pregnancy or family planning. At an individual problem level, hypertension was managed significantly less often at encounters with clinical computer users, while ‘prescription all’ (unspecified problem), female genital check-ups and general health check-ups were all managed significantly more often than at encounters with non-clinical computer users.

### **Management of problems at encounters**

*Medications:* Encounters with clinical computer users generated significantly fewer medications per 100 problems over all and significantly fewer prescribed medications.

*Prescribed medications:* Medications prescribed significantly less often by clinical computer users were: cardiovascular medications, particularly anti-hypertensives; medications acting on the central nervous system, particularly simple analgesics (specifically paracetamol); hypoglycaemic agents; musculoskeletal medications, particularly NSAIDS. Those prescribed significantly more often by clinical computer users were contraceptives, particularly levonorgestrel / ethinyloestradiol.

*Non-pharmacological management:* While the overall rates of providing non-pharmacological treatments did not differ between the two groups, clinical computer users provided significantly less counselling for nutrition / weight problems. *Referrals:* There were no significant differences between the two groups in the overall rates of referrals to medical specialists or to allied health professionals, or for any of the most common specialist or allied health professional types.

*Investigations:* Clinical computer users ordered significantly more pathology tests per 100 encounters, particularly more lipid tests; liver function tests; thyroid function tests; tests classified as haematology; and tests classified as microbiology, specifically urine MSC &

other microbiology tests. There were no significant differences between the GP groups in the overall relative rate of imaging orders, or in the rates of more specific imaging tests.

## **Multivariate analyses**

### **Characteristics of patients at encounters**

After adjustment for GP and practice characteristics, only one difference remained – clinical computer users saw significantly fewer patients who were holders of a Commonwealth Health Care Benefits card.

### **Reasons for encounter and problems managed at the encounter**

After adjustment for GP, practice and patient characteristics, patients attending a clinical computer user were significantly more likely to attend for test results and less likely to present for hypertension. There was no longer any difference in the number of problems managed per 100 encounters between the two groups. The difference in the relative rate of management of hypertension was the only difference to remain after adjustment, however a new difference emerged. Clinical computer users managed significantly more ischaemic heart disease at the encounter than their non-clinical computerised counterparts.

### **Management of problems at encounters**

Following adjustment for characteristics of the GP, the practice, the patient, and morbidity managed, all differences in overall prescribing and pathology ordering rates apparent in the univariate analyses disappeared and one new difference emerged. Clinical computer users recorded significantly fewer referrals to allied health professionals.

*Prescribed medications:* After adjustment few significant differences remained. Clinical computer users prescribed fewer antihypertensives specifically ramipril; fewer beta blockers; fewer simple analgesics, particularly paracetamol; fewer hypoglycaemic agents; and fewer musculoskeletal agents, particularly NSAIDs. One new difference emerged – clinical computer users prescribed fewer hormones.

*Non-pharmacological management:* After adjustment the only difference remaining that could be ascribed to clinical computer use was the lower rate of counseling / advice for nutrition or weight problems by clinical computer users. All differences in procedural treatments observed in the univariate analyses disappeared, and one new one emerged. Clinical computer users provided significantly fewer treatments that involved physical medicine / rehabilitation.

*Referrals:* Two new differences were observed following adjustment. Clinical computer users provided significantly fewer referrals for counselling and for rehabilitation.

*Investigations:* Following adjustment only one difference remained for pathology ordering. Clinical computer users ordered significantly more microbiology tests. A new difference emerged in the imaging orders – clinical computer users ordered significantly fewer X-rays of the spine.

## **QUALITY INDICATORS**

Thirteen domains of care, and 36 indicators within these domains, were tested for comparison of the two GP groups. Clinical computer users performed ‘better’ on 7 of these, although the clinical use of a computer remained the only explanation of differences for 3 of them. For the other 4, the differences were associated with characteristics other than the GPs’ use of a computer for clinical purposes. They performed ‘worse’ than their counterparts on 4 indicators, and there was no difference in their performance on the remaining 25. The GP

groups were identical in their length of consultation. For the 8 indicators comparing GPs who use a computer specifically for test ordering and those who do not, GPs who used the computer to order tests performed 'better' on one indicator and there were no significant differences between the two groups on the remaining 7. In total, of 44 indicators, clinical computer users performed 'better' on 4 and 'worse' on 4, where the use of a computer was the only remaining explanation having adjusted for other GP, practice, patient and morbidity characteristics. There were no differences between the GP groups for any of the remaining indicators.

## **ADVERTISING EMBEDDED SOFTWARE**

GPs using advertisement embedded software were significantly younger and more likely to live in areas other than major cities; to work in accredited practices; and significantly less likely to bulk bill Medicare for all their patients than those not using this software. There were no significant differences between the two GP groups, either before or after adjustment, in the prescribing rate for six of the seven products examined. For the seventh, a significant difference emerged (before and after adjustment) between the two groups – the GPs who were exposed to advertising through their software prescribed this product less often than those not exposed to the advertisements through their clinical software, suggesting a negative effect of the advertising on GP prescribing behaviour. When the seven products were combined there was no difference in the overall prescribing behaviour between the two groups either before or after adjustment.

## ***Conclusion***

This study has demonstrated that, while there are some differences in the behaviour patterns of GPs who use a computer for clinical purposes, many of the real differences are associated with characteristics other than their use of a computer. The use of a computer for clinical purposes has not to date produced any discernable benefit or improvement in the quality of care provided to patients, despite the time and monetary costs associated with their use. GPs do not appear to be influenced by the presence of advertisements in their clinical software, which is a positive outcome for those concerned with quality use of medicines, but may indicate a waste of resources by non-for-profit organisations and public institutions who advertise through this medium.

# 1 Introduction

## ***Background and literature review***

The computer as a tool for organising information became a possibility for professionals and individuals when third generations computers (1964-1970) replaced magnetic core memory with the integrated circuit. Technologically, the fifth generation began in the mid 1970's with the microcomputer. Microcomputers became popular in hospitals, with approximately 75% of US community hospitals using microcomputers by 1985.(1) Computers were gaining popularity in the Australian health system during the same decade.

The Royal Australian College of General Practitioners (RACGP) has been actively exploring and advocating the use of computers in general practice since the late 1970s,(2) and held their inaugural National Computer Conference in 1978.(3) Through the early 1980s the uptake of computers for accounting and practice management had increased, but use for clinical applications was minimal.(4) In July 1985, Medrecord Computer Systems proposed to the RACGP that Medrecord computer medical record systems be established in 20 representative practices around Australia. As a result of this proposal, the College and Medrecord jointly sponsored the Computer Assisted Practice Project (CAPP) in 1985.(4)

Between 1986 and 1989 the CAP Project oversaw the installation of computerised patient record systems in 42 Australian general practices. Acceptance of the new technology by doctors, practice staff and patients was high. The findings were valuable to the ongoing development of information systems, and raised several issues to be addressed throughout the development process. These included cost, increased consultation time (in some practices), adequate backup routines to protect data, improvements for report generation, the necessity of a coding system for use in Australia, and data portability across computer systems to enable transfer of data to upgraded systems when those in use are superseded. The prime issue to be addressed was the provision of high quality, functional software.(4)

Through the 1990's there was a concerted drive towards computerisation for general practice in Australia. Federal Government initiatives, combined with those of some state and territory health departments and various groups within the profession, have resulted in a dramatic increase in the uptake of computer use by general practitioners (GPs) in recent years.

Since the commencement of the Australian General Practice Strategy in 1989, the (then) Commonwealth Department of Health and Family Services has funded a variety of projects aimed at encouraging the adoption of electronic information systems "to enhance clinical and practice management".(5) The Demonstration Practice Grants Program was announced in 1991, and the Federal Government allocated \$12 million for 10 demonstration general practice divisions and several hundred projects managed by individual GPs.(6)

A major initiative of the Strategy was the establishment of Divisions of General Practice with Commonwealth funding in 1992.(7) The Divisions accelerated the development of information management and information technology through project funding. By 1996 the Commonwealth had awarded 95 grants to divisions for short-term projects with a strong IT component. A policy change for the Divisions of General Practice Program (DGPP) in 1997 resulted in a move away from short-term project funding towards longer-term outcomes-based programs funded with block grants. Divisions use these grants to provide IM/IT support for general practice including provision of information services, educational opportunities for GP members, and ongoing support from divisional staff with IT expertise. Since the block funding arrangements were initiated there has been a 16-fold increase in

expenditure on divisional programs with an IM/IT focus compared to the earlier short-term project era.(3)

In 1998 the General Practice Strategy Review Group (GPSRG) developed guidelines to support the development and implementation of information management (IM) and information technology (IT) in practices, proposing a principal role for IM / IT in data collection and validation.(8) The Group outlined the developments undertaken to provide the basis for computers to be used routinely as clinical support systems. These included the documentation of information flows in general practice; the development of standards and codes of practice for clinical coding, privacy of medical information, functional specifications for software, technical framework for clinical and administrative general practice systems, and computerised medical records; the examination in detail of potential benefits of electronic prescribing and medicines information; the data requirements of forms used in general practice; as well as a range of projects including IT demonstrations and trials of networks between GPs and other sectors of the health system.(8,9)

In 1997 the RACGP and the AMA collaborated to develop a “Strategic Framework for Improved Information Management through the use of Information Technology in General Practice” which aimed to promote the uptake of information technology in general practice(3) They followed this in 1998 with a ‘Strategic Framework for Clinical and Administrative General Practice Computers’ followed by the publication of *Principles for the Implementation of Computerisation in General Practice: a plan for the next three years*. The RACGP also produced the *Code of Practice for the Management of Health Information in General Practice* which provides ‘a foundation for the ethical management of information in general practice’.(9)

The GPSRG felt that general practice-related developments in information management and information technology were not progressing adequately under the Strategy. They included in their vision statement for general practice in the 21<sup>st</sup> century that general practitioners will “be assisted in the care of patients through utilising advanced technology, electronic communication links with providers of health services, and information systems to guide best practice”.(9) A series of recommendations resulted, aimed at increasing the use of computers and other information systems through the provision of incentives to computerise and funding to promote usage, provide training, backup and advice.(9) An example of these incentives was the announcement by the Health Insurance Commission that all charges for computerised prescription paper would be dropped in 1999 following a decade of lobbying.(7)

As stated by Richards et al (1999),(3) the development of information management in the Australian health system had been poorly co-ordinated since its inception, with initiatives starting at all levels from individual practices through to various Branches of the (now) Australian Government Department of Health and Aging (DoHA). Their report highlighted the need for the development of national standards, of local and national networks between GPs and other health and community services, and of the need for ongoing practical training and support for GPs.(3)

The Practice Incentive Program (PIP) began in July 1998 in response to a series of recommendations made by the GPSRG.(7) The PIP ‘aims to recognise general practices that provide comprehensive, quality care, and which are either accredited or working towards accreditation’ against the RACGP *Standards for General Practice*.(10) Payments focus on aspects of general practice that contribute to quality care, including the use of information management/information technology (IM/IT).(10)

Financial support through the PIP (since July 1999) has assisted general practices to adopt information technology by providing remuneration to practices who use prescribing software and have the capacity to send and receive electronic clinical information.(7) The formula for the IM/IT element has three tiers of payment – Tier 1 is for providing data to the Commonwealth; Tier 2 is for the use of bona fide electronic software to generate the majority of prescriptions in the practice; and Tier 3 requires that the practice has on site and uses a computer/s connected to a modem to send and/or receive clinical information.(10)

The General Practice Computing Group (GPCG) was established in 1997, initiated jointly by the RACGP and the AMA with funding from the (then) Australian Government Department of Health and Aged Care to implement and oversee the Strategic Framework plans. The GPCG developed the strategic framework in 1999, based on the strategies outlined in *Principles for the Implementation of Computerisation in General Practice*(11) and the recommendations of the GPSRG report.(9) It became the peak body for general practice computing, providing a strategic and co-operative approach to Australian GP informatics,(12) and focusing on ‘the effective use of information management and technology for clinical and administrative purposes’.(13) The GPCG operated through a management committee comprised of four elected members of the GPCG, stakeholder representatives from the RACGP, the AMA, the Rural Doctors Association of Australia (RDAA), the Australian Divisions of General Practice (ADGP), the Medical Software Industry Association (MSIA), a health consumer and two representatives of the general practice branch of the (then) Department of Health and Aged Care.(7) GPCG projects undertaken from 2001 included: practical support for GPs via divisions of general practice; the GPCG IT Clearinghouse Initiative; the Standards Development Program; the Development and Evaluation Program; and the Information Management Program.(7)

In November 1999, under the guidance of the National Health Information Management Advisory Council (NHIMAC), and funded by DoHA, *HealthONLINE* was released as the strategic framework for health information management and technology activities nationally. This project also incorporated *HealthINSITE*, an internet-based ‘gateway’ information service to be made available to the public to enable informed healthcare decisions. The service was to provide high-quality information from a broad range of ‘approved information partners’.(14)

In 2000, as part of the broader *HealthONLINE* initiative, the National Electronic Health Records Taskforce proposed a national health information network called *HealthCONNECT*. With a consumer’s permission this network would facilitate the safe collection, storage and exchanges of his/her health information between authorised health care providers.(15) Trials were undertaken in Tasmania and the Northern Territory. In parallel, the proposed medicine component of *HealthCONNECT* was being field tested in Launceston and Ballarat. This component was called *MediCONNECT* (formerly the Better Medication Management System) and was to draw together personal medicines information held by different pharmacies, doctors and hospitals through a secure national electronic system under strict privacy guidelines.(14)

The *HealthCONNECT* and *MediCONNECT* trials highlighted the issues raised by Richards et al earlier.(3) For an electronically connected health system in Australia to succeed, success will first be required in the development of unique patient identifiers, adequate safeguards for privacy, consent and access control, and agreed standards in the areas of: data elements; terminologies and vocabularies; communication and data exchange; storage architecture; documentation and message format; imaging; security; and entity identification for providers, facilities, devices etc.(15)

Although the reasons were not publicly discussed, the HealthCONNECT process stalled in 2004, and many of its objectives are now being undertaken by the National E-Health Transition Authority (NEHTA). NEHTA was established in July 2005 by the Australian Commonwealth, State and Territory Governments(16) to facilitate the adoption of e-health across the health sector. NEHTA's focus is e-health informatics standards and interoperability of infrastructure.(17)

The work of NEHTA encompasses the Australian health system in its entirety. The interconnection of the various components of the health system can only occur once the interoperability of those separate components has been achieved. However, for each of those individual components to be ready to connect with a wider network, one would assume that a level of computerisation had been achieved within each of those component groups. The Australian Government Department of Health and Ageing (DoHA) announced the withdrawal of funding from the GPCG in April, 2005, and the authors of this report question whether this decision was arrived at on the assumption that general practice has already achieved an optimum level of computerisation. To date, it is unclear who will provide the support the GPCG has been providing to assist GPs in this area, although Divisions have been assisting in the short term.

If this decision was based on the assumption that general practice has achieved a 'satisfactory' level of computerisation, the number of practices reporting computer availability at accreditation or claiming PIP payments may have influenced this assumption. In July 2003, 87% of the estimated 6,000 general practices in Australia had undertaken accreditation against the RACGP standards.(18) In the 2003-04 BEACH year, 98% of participants in accredited practices reported also having a computer available (unpublished data). The Productivity Commission recently reported that PIP practices in 2004 covered around 80% of Australian general practice patients, that 93.2% of these practices were prescribing electronically and 92.0% were using computers to send and/or receive data.(19) This evidence depicts a rapid uptake of computers in general practice over only half a decade. An earlier study by AC Nielsen in October 1997 had found that only 31.0% of practices had computers. Of these, most practices used the computer for a combination of administration and clinical uses (74.0%), while 19.0% were administrative users only and 7.0% were clinical users only.(5)

The move to computerise general practice over the past three decades seems to have advanced from an underlying premise that the use of a computer will improve various aspects of management and care. There is a general theme among the literature of that period that using a computer will 'improve' the management of health information by facilitating the provision of information needed to assess performance of individual practitioners, to evaluate programs, to monitor patient disease and risk management, and to provide data for research.

However, Richards et al (1999) reported that they had found little hard evidence that the general use of computers improves efficiency at individual practice level. They raised concerns about the lack of evidence that computers benefit the health sector generally or that improving outcomes was an aim when designing information systems, and further, evidence from the business sector suggesting that information technology costs more than it delivers through direct and opportunity costs.(3) This is not just a local trend. Healthfield et al proposed that decision makers in the UK and the US may be being 'swayed by the general presumption that technology is of benefit to health care and should be wholeheartedly embraced' while the evidence to either support or oppose this supposition is still scarce.(20)

Mitchell & Sullivan (2001) undertook a systematic review of world literature on primary care computing from 1980 to 1997.(21) Only 89 studies met their inclusion criteria and while

most of these found some positive effects of computerization in areas such as immunisations, reductions in prescribing costs and unnecessary testing, they found only 17 studies researching the impact of computers on patient outcomes, a number they concluded insufficient to measure whether computers provide real benefits for patients.(21). A further similar search of relevant databases and other sources up to the time of commencing this study produced little that could be added to the evidence tally for patient outcomes in primary care.

Nonetheless, few would argue that the potential exists for computerization to fulfill the ideal of improved health surveillance and delivery. The ability to provide a clearly printed prescription should theoretically reduce medication errors caused through illegibility. The storage of complete patient health information in one electronic record should improve access to complete and timely information when preparing referrals or ordering tests, or communicating between health care providers. Reminders for tests or warnings about medication interactions with other medications or contraindicated conditions should help to monitor patient conditions and reduce adverse events. There is some evidence of these types of individual improvements to the quality of care associated with computer use(22-24) but there is also evidence appearing that the computer, while solving problems in some areas, is causing or accentuating different ones elsewhere.(25-28)

In considering how computer use may affect the quality of care, evidence is needed in order to determine whether there are differences in the behaviour of GPs who use a computer for clinical purposes compared to those who do not. Prescribing behaviour is also an area where the influence of advertising embedded in clinical software has been questioned, given that it could influence practitioners to prescribe a well-promoted product in place of an equally efficacious one, which may incur a higher cost to the patient or to the Government via the Pharmaceutical Benefits Scheme (PBS).

To what extent individual GPs use computers for clinical purposes is unknown, as is the effect using computers for clinical purposes has on the quality of care provided to patients. The effect of pharmaceutical advertising on the prescribing behaviour of GPs so exposed has also not been examined to date. Our study therefore has several aims:

1. to investigate the access GPs have to computers at their major practice address, and the extent to which individual GPs report using their computer for a range of clinical purposes
2. to examine whether GPs who use a computer in their clinical activity differ in their practice behaviour compared to GPs who do not use a computer for clinical purposes
3. to examine whether GPs who use a computer for clinical purposes differ from their non-computerised counterparts on a range of quality indicators applicable to general practice outcomes
4. to compare the prescribing behaviour of GPs who use advertising embedded clinical software with those not exposed to advertising via this medium to determine whether this advertising influences the way GPs prescribe.

As this project has four main aims, I have decided to present the detailed methodology and results for each in a separate chapter. A description of the general methodology is described in Chapter 2.

## 2 Methods

This study is a secondary analysis of data from the national Bettering the Evaluation and Care of Health (BEACH) program, with some additional methodology. The BEACH methods have been published in detail elsewhere but relevant features are summarised here.(29) BEACH is a paper-based, continuous cross-sectional survey of general practice activity. Each year approximately 1,000 GPs from a national rolling random sample (drawn by DoHA) participate in BEACH. GPs provide patient demographics and encounter information for 100 consecutive, consenting, unidentified patients. They also provide demographic information about themselves and their practices on a GP profile questionnaire.

**Note** – The methodology of BEACH reported annually describes how and why weighting is applied each year for the sample of BEACH GPs who have recorded data during that year. The Medicare Australia data supplied for comparison with BEACH data are for the specific 12 month period only. As participants and data combining two separate BEACH data collection periods were used in this study (participants from the latter third of 2003-04 and all participants from 2004-05), it is not methodologically sound to apply weighting to these GPs and data. An unweighted comparison of the study participants with all active recognised GPs in Australia in 2004 is presented in Chapter 3 (Table 3.1). An unweighted comparison of the age-sex distribution of (BEACH) patients in this study with that of patients for whom MBS A1 services were claimed during 2004 is also presented in Chapter 3 (Table 3.2).

### ***Supplementary Analysis of Nominated Data (SAND)***

A section at the bottom of each patient encounter form is called the Supplementary Analysis of Nominated Data (SAND) and investigates aspects of patient health or health care delivery in general practice that are not covered by the encounter-based information. The SAND section and methodology are described in detail elsewhere(30) but were not utilised in this study, with one exception. Forty of the forms in each GP research pad were used to record the starting time and the finishing time for the consultation.

### ***Additional methods used in this study***

The BEACH method summarised above formed the basis of this study, with some additional techniques. All GPs who completed a BEACH data collection kit in the period 28/10/03–28/03/05 were included in this study. Additional methods utilised in this study are described in detail in the Chapters in which they were applied.

### ***Statistical methods used in BEACH***

The analysis of the BEACH database is conducted with SAS versions 6.12(31) and 8.2(32) and the primary unit of analysis is the encounter. Proportions (%) are used only when describing the distribution of an event that can arise only once at a consultation (e.g., patient age, patient sex or item number) or to describe the distribution of events within a class of events (e.g., problem *A* as a percentage of total problems). Rates per 100 encounters are used when an event can occur more than once at the consultation (e.g., RFEs, problems managed or medications).(33)

Rates per 100 problems are also used when a management event can occur more than once per problem managed, e.g. when a prescription is provided. In general, however, the results present the number of observations (*n*), the rate per 100 encounters and the 95% confidence intervals (CI).(33) Non-overlapping CIs indicate a statistically significant difference between the results being compared.

The collection of information about patients is often easier, more appropriate and more cost effective if the support of a number of GPs is enlisted. These GPs provide access to a number of patients. This type of sampling is called ‘cluster sampling’ as clusters or groups of patients around a GP are used for the investigation.(34) However, patients around GPs tend to have a degree of similarity in some characteristics so it is important that sample size estimates consider the differential clustering effect for the different variables under investigation. The BEACH study is essentially a random sample of GPs, each providing data about a cluster of encounters. Cluster sampling study designs 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.(34)

There is also a secondary probability function of particular types of encounters being included in the GP’s cluster (associated with the characteristics of the GP or the type and place of the practice). In addition, there will be inherent relationships between encounters from the same cluster. Together these design effects of a cluster sample usually result in decreased precision of national estimates.(33)

Therefore, when a study design other than SRS is used, analytical techniques should be employed that consider the study design, and reflect the increased uncertainty around the estimates. The BEACH study has demonstrated appreciable design effects that need to be adjusted for in reporting the precision around any estimates.(35) In BEACH reporting, and in this report, the standard error calculations used in the 95% confidence intervals accommodate both the single-stage clustered study design and sample weighting according to Kish’s description of the formulae.(36) In this study, SAS V6.12(31) was used where programs had previously been written which could be used for some of these analyses, and because of limitations in its capacity to calculate the standard error for the current study design, additional programming was required to incorporate the formulae.(33) SAS V8.2(32) includes procedures that calculate the robust standard error to adjust for the intra-cluster correlation of the cluster sample,(33) and was used for all analytical programs written specifically for this study.

### ***Statistical methods used in this study***

In this study, results are reported in terms of the number of observations (n), proportions (%), rates per 100 encounters, rates per 100 problems managed, and the 95% confidence intervals. Chi square statistics were applied to the measurement of differences in GP characteristics. The descriptive analyses performed in this study were conducted with SAS version 8.2.(32) STATA 8.2(37) was used for both univariate and multivariate analyses.

We used general linear modelling to compare the two groups of GPs described in each Chapter on a range of outcomes. Potential confounding variables were identified and adjusted for, using a series of models built on a hierarchical basis, with the ‘families’ of predictors (e.g. the ‘family’ of GP characteristics or the ‘family’ of patient characteristics) fitted depending on the outcome of interest. The outcomes specific to each topic of interest are detailed in each of the associated Chapters, as are the final sets of models applied for the topic investigated within each Chapter. While the final models varied slightly for each topic, the general process for building the models was similar and is described below.

### **Univariate analysis**

I compared the two groups in each Chapter (according to the aim being investigated) on variables of interest using univariate analysis to identify any relationship between the groups and the individual outcome variable. For these analyses, outcome variables were collapsed

into dichotomous variables. Multiple logistic regression was used to analyse categorical outcomes and multiple regression to analyse continuous and ordinal variables (e.g. length of consultation or patient age distribution).

In logistic regression the results are expressed as odds ratios where one group (for example, GPs not using a computer for clinical purposes), is used as the reference group. If the 95% confidence intervals for the odds ratio do not include 1, the difference between the groups is statistically significant. An odds ratio of 1 implies that the event is equally likely in both groups. For example, in Chapter 3, an odds ratio of greater than 1 implies that the event is more likely in the group of GPs who use a computer for clinical purposes, while an odds ratio of less than 1 implies that the event is less likely in the group of GPs who use a computer for clinical purposes. An odds ratio of 1.3 (OR=1.3) is interpreted as: this event is 1.3 times more likely for GPs who use a computer for clinical purposes than for GPs who do not. An odds ratio of 0.7 (OR=0.7) is interpreted as: this event is 0.7 times less likely to occur for GPs who use a computer for clinical purposes than for GPs who do not.

For the multiple regression used to analyse continuous variables, the results are reported in terms of the regression coefficient (RC) and *P* values. In this study *p*-value of 0.05 has been selected as the decision level for determining whether an independent variable had an effect on a dependent variable or that any difference between groups is due to random effects. Therefore, a *p* value of <0.05 indicates a significant effect of that predictor on the outcome.

### **Multivariate analysis and models used**

The multiple variables collected in BEACH necessitated adjustment for multiple potential confounding variables. There is a need to determine what characteristics of the GPs or their practices should be considered or adjusted for in order to determine whether differences in patients/problems/managements found in the descriptive analyses can be explained by the significant differences in the GPs or their practices, or are independent of these. A series of regression models was designed in a step-wise manner using backward elimination. While the outcomes investigated and the variables included in the final models differed for each aim being investigated, the development of the models followed the same process which is described below.

#### ***Model Type A – adjustment for GP and practice characteristics***

For patient outcomes, GP and practice characteristics were compared for the two GP groups being evaluated for each chapter, and differences identified using the chi-squared test and simple logistic regression. The covariates showing some association ( $p < 0.10$ ) with the dependent variable were included in the model reduction procedure. The final model included covariates that showed an association at  $p < 0.05$ . Characteristics retained in the final model applied to the comparison of patient outcomes are referred to in each Chapter as Model Type A, and are specified in the results section of each Chapter.

#### ***Model Type B – adjustment for GP and practice characteristics (as per Model A) and patient characteristics***

For morbidity outcomes, i.e. the problems managed at the encounter (at ICPC Chapter level), a number of patient characteristics were compared between the two GP groups being evaluated for each chapter. The denominator was the patients attending the sample of GP-patient encounters. The GP and practice characteristics (i.e. those covariates ultimately included in Model A) were incorporated as covariates in this stage of the modelling. The covariates retained in the final model applied to the comparison of morbidity outcomes are

referred to in each Chapter as Model B, and are specified in the results section of each Chapter.

### ***Model Type C – adjustment for GP, practice and patient characteristics (as per Model B) and morbidity***

Management actions are highly associated with the morbidity being managed and so the presence of morbidity in any ICPC Chapter was adjusted for in the Type C model. Where the outcome was problem management, i.e. the managements provided at the encounter, the denominator was the sample of GP-patient encounters. The GP, practice and patient characteristics (i.e. those covariates ultimately included in Model B) were incorporated as covariates in this stage of the modelling. The covariates retained in the final model applied to adjust for GP, practice, patient characteristics, and morbidity are referred to in each Chapter as Model C, and (where used) are specified in the results section of each Chapter.

### ***Modeling of quality indicators***

A series of models structured along the above lines were used to analyse the quality indicators applied in this study. Based on the GP-patient encounters, the analyses were performed on sub-samples (of encounters or problems) that varied according to the criteria for each quality indicator. The outcomes were continuous variables expressed as rates per 100 sub-sample encounters, or rates per 100 sub-sample problems, e.g. rates of antibiotics prescribed per 100 contacts with upper respiratory tract infection; rates of HbA1c tests ordered per 100 diabetes problems managed.

### **Power calculations**

Despite the use of random samples and adjustments for cluster effects, there is always a chance that samples will appear to confirm or disprove a hypothesis when in reality the opposite is true. The chances of incurring either a Type I or Type II error are lessened when sample sizes are appropriate. If too few subjects or cases are used, a hypothesis test will have too little statistical power to reliably detect a significant effect. In order to determine the extent to which any conclusions formulated from the results emerging from these analyses are reliable, statistical power calculations were performed. It was decided that a power value of 0.8 would be adequate as a standard for hypothesis testing in this thesis.

We undertook power calculations using Stata 8.0 (comparison of proportions) to determine the reliability of results between the two GP groups at  $\alpha=0.5$  level. Power calculations were performed whenever the assignment of GPs to groups changed. For example: in Chapter 4 GPs were assigned to groups on the basis of their use of a computer for clinical activity; in Chapter 5 they remained in their Chapter 4 groupings for the majority of the indicators analysed, and then were reallocated to groups on the basis of their use of the test ordering function of their software; in Chapter 6 their group assignment was determined by their use of Medical Director<sup>®</sup> software.

A priori calculations were undertaken on the major samples prior to specific investigations. At the outset we had no published research on which to base the estimates of how many GPs in each of these groups would prescribe a branded medication, so in Chapter 6, post hoc calculations were also undertaken on the sub-groups of GPs who prescribed medications from the ATC classes or groups for each of the selected medications for which advertised brand prescribing was being compared. Some of the resulting samples appeared small and consequently introduced caution regarding their statistical power. The use of post hoc power calculations is controversial – some statisticians believe they are inappropriate, while others

feel the greatest reliability comes from calculations involving actual numbers rather than estimates.(38,39) The results of all power calculations are reported in individual Chapters.

### **Group variables of interest**

Because several topics of interest were examined through the total sample of GPs in this study, the GPs were reorganised into different sub-samples in each Chapter according to the aim under investigation and their status according to that topic. Similarly, the group variables of interest also changed according to the topic under investigation.

In Chapters 4 and 5 the group variable for all models was clinical computer use status. GPs not using computers for clinical purposes made up the reference group against which the group who use their computer for clinical activity (the experimental group) was compared.

In Chapter 6 the group variable for all models was the use of software containing embedded advertising. GPs not using advertising embedded software made up the reference group against which the group who use advertising embedded software (the experimental group) was compared.

### ***Ethics approval***

All of the research processes used in this study were approved by the Human Ethics Committee of the University of Sydney and the Ethics Committee of the Australian Institute of Health and Welfare. All changes to the data collection tools, and the tool introduced for this project, were approved by the Australian General Practice Statistics and Classification Centre Management Committee prior to subsequent approval by the Ethics Committee of the Australian Institute of Health and Welfare, on behalf of the Institute and the University of Sydney.

### 3 Computers in general practice – who’s using them and how?

As previously described, computers were initially used in general practice for administrative purposes, but over the past decade they have provided GPs with alternate methods by which to prescribe, refer, order investigations, receive test results, record and store clinical data and access assistance with clinical decisions.

However, having a computer available at the work place does not necessarily assure its use. There are many functions available to the GP through their practice software, and GPs are free to use all, some or none of these functions in their clinical activity. Computers are readily available at the majority of practices in Australia, but the extent to which individual GPs use their computer, and the clinical purposes for which they are used, has not yet been examined.

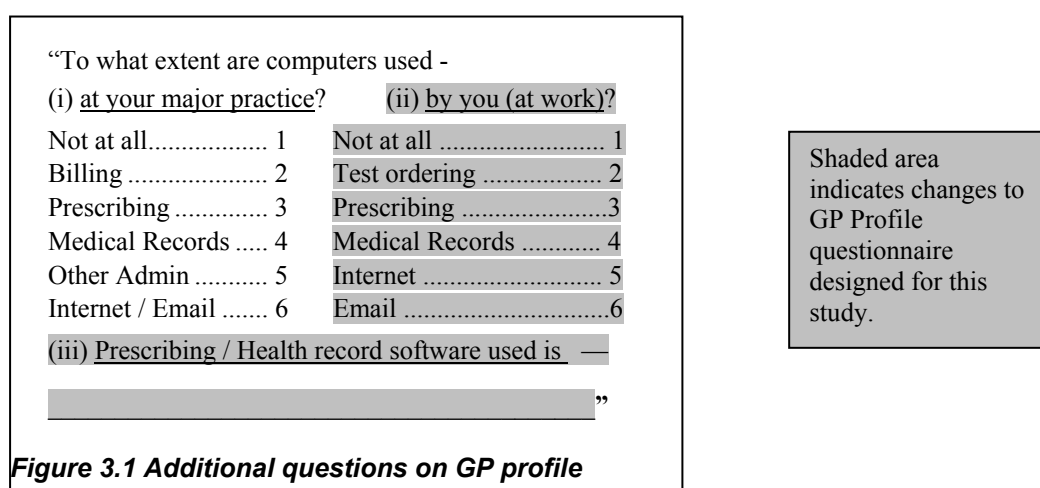
The aim of this Chapter is to investigate the availability of computers to GPs at their major practice address, to determine the purposes for which these computers are used, and the proportions of individual GPs who use their computer for any, or all, of a range of clinical activities.

#### 3.1 Methods

The methods utilised for this chapter are those of the BEACH methodology described in Chapter 2, with the addition of the following:

##### 3.1.1 The GP Profile questionnaire

Preceding this investigation, the GP Profile questionnaire focused on the availability of computers in practices with the question ‘to what extent are computers used at your major practice address?’. Options were: ‘not at all’; ‘billing’; ‘prescribing’; ‘medical records’; ‘other admin’; and ‘internet/email’. The doctors were instructed to circle as many options as were applicable. On planning this project, I realised that the question in this format was not specific enough to determine the level of clinical computer use by individual GPs. In October 2003 the computer use questions were redesigned (see Figure 3.1) to read:



Following Ethics approval, the newly formatted GP profile was distributed to GPs with their recording kits.

### 3.1.2 The follow-up questionnaire

From the parallel literature review, it became obvious that GPs may use computers for storing patient information at a variety of levels – some GPs use electronic records only, some use a hybrid system of electronic and paper records for the same patients, and some store the majority of their patient information on paper and only keep some information (e.g. prescriptions, referrals, pathology orders etc) in the computer. When designing the initial analyses it became evident that the new question about computerised medical record use on the GP profile questionnaire was still not sufficiently specific to determine the type or amount of patient information being stored electronically by GPs who reported personal use of computers for medical records. Consequently, a follow-up questionnaire was designed intended for all GPs who had indicated on their GP profile that they personally used the computer for medical records. The questions asked are presented in Figure 3.2.

***To what extent did you use a computerised medical record for your patients at the time you participated in BEACH?***

1. (Please tick)  All clinical patient information (eg. patient history, diagnoses/problems, treatments, referrals, requests etc) generated by you is held on computer, i.e., no paper records generated. All test results and other external correspondence are imported or scanned into the computer record. **OR**

2.  All clinical patient information (eg. patient history, diagnoses/problems, treatments, referrals, requests etc) generated by you is held on computer, i.e., no paper records generated. All test results and other external correspondence are kept on paper. **OR**

3.  Patient history  
 Current problems being managed  
 Prescriptions  
 - problem for which script was given  
 Tests ordered  
 - problem for which test was ordered  
 Referrals  
 Immunisations

- are held on computer (through software); all other clinical patient information is recorded on paper. ***Tick as many as apply. We will assume that any item not ticked is held on paper.***

**Comments**

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***Figure 3.2 Follow-up questionnaire about computerised medical record***

Tick box options were offered indicating differing levels of use, ranging from all clinical patient information including all test results and correspondence, to individual components such as prescriptions, test orders, referrals or immunisations. A free text section was also included to allow the GPs to make any comments they chose (see Figure 3.2). Following Ethics approval, the follow-up questionnaire was posted to all GPs who had nominated 'Medical Records' as an individual computer use on their GP profile.

GPs who returned the questionnaire were divided into those who kept all patient information in the computerised medical record made available through their clinical software (Option 1 in Figure 3.2) and those who did not keep all patient information in the computerised format but kept some in a paper record (Options 2 and 3).

## **Definitions**

*Computer availability* was defined as: a computer is available (whether used or not) at the major practice address.

*Computer use* was defined as: a computer is used by the responding GP for any function.

*Clinical computer use* was defined as: the GP's use of a computer for some or all clinical function(s), i.e., prescribing, test ordering, medical records.

*Non-clinical computer use* was defined as: the GP's use of a computer for administrative functions, internet and/or email only; without use of clinical components.

*Medical record use* was defined as: the GP's use of the clinical records component of medical software for storage of some or all patient data.

*Fully computerised* was defined as: the GP uses the medical records component of clinical software for all patient data including externally generated correspondence.

*Partially computerised* was defined as: the GP uses the medical records component of clinical software to store some but not all patient information.

### **3.1.3 The participants**

The 1,336 GPs who participated in BEACH between 28/10/03–28/03/05 have been included in the analyses for this Chapter.

### **3.1.4 Statistical methods used in this Chapter**

The analyses for this Chapter were conducted with SAS version 8.2.(32)

The following results are reported in terms of the number of observations (n) and proportions (%). Where GPs did not provide responses, they were removed from the total sample before calculations. Denominators vary according to the component being analysed (e.g., all GPs, GPs with computers, GPs with clinical software).

## **3.2 Results**

### **3.2.1 Representativeness of GPs and encounters in this study**

The importance of a representative sample, and the weighting process to ensure the representativeness of the GPs and encounters in BEACH was referred to in Chapter 3. As the weighting is applied annually to assess how well each annual BEACH GP sample compares to the national sample frame, and the sample of GPs used in this study crossed over two different BEACH recording years, I have not used weighted data for these analyses.

However, in order to ascertain how well the GPs and encounters in this sub-study represent the national situation, I have compared the total group of GPs (from the latter part of 2003-04 and the entire group from 2004-05) with the national sample frame for the year from which the greater proportion of GPs was taken, and the patient encounters with Medicare data from the same period. Table 3.1 shows the comparison of the 1,336 GPs who formed this study sample, compared to the national sampling frame for 2005.

In the 2003–04 BEACH year, GP participants were significantly less likely to be aged less than 35 years when compared to the national sample ( $\chi^2=29.5$ ,  $p<0.001$ ).<sup>(33)</sup> This under-representation of younger GPs has occurred in preceding years of BEACH and was hypothesised to result from the lack of requirement for GPs undertaking a general practice vocational training program to participate in quality assurance (QA) activities either during training, or in the QA triennium in which they completed training. The offer of QA points is less likely to attract them, and most of these GPs are aged less than 35 years old.

This hypothesis gained support in the 2004–05 BEACH year (participants included in this study). It was the start of a new triennium and coincided with a change in the QA requirements for new graduates to now complete a clinical audit activity in the triennium of the completion of their training. It was also the first year since BEACH recording began, where the GPs in this age-group were not under-represented. However, when the portion of GPs from the 2003-04 year was added to the 2004-05 sample (i.e. the participants in this study) there was again an under-representation of younger GPs (<35 years). This was the only significant difference between GPs in this study sample and those in the national sample frame (Table 3.1).

To assess the representativeness of the sample of patients at encounters with the 1,336 GPs in this study, the age-sex distribution of the patients at A1 Medicare claimable encounters recorded in this study was compared with that of all encounters claimed in 2004 as Medicare A1 items of service (data provided by the DoHA). Table 3.2 shows this comparison. Overall, there is a good fit of the age and sex distribution without weighting, between the MBS data and the patients at encounters with the GPs in this study. No age-sex category varied by more than 20% from the population distribution. The raw precision ratios for all categories (0.9–1.2) show that the study sample of encounters is a good representation of general practice patient encounters in Australia.

**Table 3.1: Comparison of study participants and all active recognised GPs in Australia**

GP characteristic	Study (BEACH) participants <sup>(a) (b)</sup>		Australia <sup>(a) (c)</sup>	
	Number <sup>(a)</sup>	Per cent of GPs <sup>(a)</sup> (n=1,336)	Number <sup>(a)</sup>	Per cent of GPs <sup>(a)</sup> (n=18,112)
Sex (Missing) ( $\chi^2=1.448$ , p=0.228)	(0)		(0)	
Male	904	67.7	11,963	66.0
Female	432	32.3	6,149	34.0
Age (Missing) ( $\chi^2=11.007$ , p<0.01168)	(5)		(0)	
<35 years	109	8.2	1,859	10.3
35-44 years	331	24.8	4,564	25.2
45-54 years	432	32.3	6,071	33.5
55+ years	459	34.6	5,638	31.1
Country of graduation (Missing) ( $\chi^2=0.095$ , p=0.758)	(1)		(0)	
Australia	949	71.1	12,961	71.5
Overseas	386	28.9	5,171	28.5
State (Missing) ( $\chi^2=10.7$ , p=0.157)	(3)		(0)	
New South Wales	462	34.7	6,103	33.7
Victoria	315	23.6	4,489	24.8
Queensland	252	18.9	3,416	18.8
South Australia	116	8.7	1,523	8.4
Western Australia	115	8.6	1,629	9.3
Tasmania	36	2.7	505	2.8
Aust Capital Territory	17	1.3	269	1.5
Northern Territory	20	1.5	135	0.7
RRMA (Missing) ( $\chi^2=7.598$ , p=0.269)	(0)		(0)	
Capital	877	65.6	11,802	65.1
Other metropolitan	88	6.6	1,358	7.5
Large rural	71	5.3	1,088	6.0
Small rural	91	6.8	1,272	7.0
Other rural	169	12.6	2,245	12.4
Remote centre	16	1.2	164	0.9
Other remote	23	1.7	203	1.1

(a) Missing data removed.

(b) Data drawn from the BEACH GP Profile completed by each participating GP.

(c) All GPs who claimed at least 375 A1 Medicare items during the most recent 3-month Medicare Australia data period. Data provided by the Primary Care Division of the Australian Government Department of Health and Ageing.

Note: RRMA—Rural, Remote and Metropolitan Area classification

**Table 3.2: Age-sex distribution of patients in study sample (from BEACH) and MBS A1 services for 2004**

Variable	Study BEACH) participants <sup>(a)</sup>		Australia <sup>(b)</sup>	Precision ratio
	Number	Per cent	Per cent	unweighted
Male				
< 1 year	1,256	1.2	1.2	1.0
1– 4 years	2,623	2.5	2.8	1.1
5–14 years	3,139	3.0	3.5	1.2
15–24 years	3,429	3.2	3.4	1.1
25–44 years	9,521	8.9	9.1	1.0
45–64 years	12,386	11.6	11.7	1.0
65–74 years	6,120	5.7	5.7	1.0
75+ years	4,691	4.4	4.6	1.1
Females				
< 1 year	1,030	1.0	1.0	1.0
1– 4 years	2,328	2.2	2.5	1.1
5–14 years	3,109	2.9	3.3	1.1
15–24 years	6,594	6.2	5.9	1.0
25–44 years	16,850	15.8	14.9	0.9
45–64 years	17,435	16.4	15.4	0.9
65–74 years	7,600	7.1	6.7	0.9
75+ years	8,427	7.9	8.2	1.0

(a) Unweighted data, A1 items only, excluding encounters with patients who hold a DVA Repatriation health card.

(b) Data provided by the Primary Care Division of the Australian Government Department of Health and Ageing.

### 3.2.2 Computer availability at the major practice address

Between October 2003 and March 2004, 1,336 GPs participated in the BEACH program and all completed and returned a GP profile questionnaire. Of the 1,336 participants, 17 did not respond to questions about computer availability and were removed from this analysis. The remaining 1,319 respondents represented 1,190 individual practices, as the sampling process for BEACH involves individual GPs, not practices, and some practices had more than one GP participate during the study period. Of the 1,319 respondents, 79 (6.0%) did not have a computer available in their practice (Table 3.3). Counting each practice once, the proportion of practices without a computer available was 6.3%.

**Table 3.3 Computer availability at major practice address**

	Number of GPs	Per cent of all GPs (n=1,319) <sup>(a)</sup>	Per cent of GPs with practice computers (n=1,240)
No computer	79	6.0	—
<b>Computer available for:</b>			
Billing	1,050	79.6	84.6
Prescribing	1,101	83.5	88.8
Medical records	934	70.8	75.3
Other administrative	974	73.8	78.5
Internet / Email	888	67.3	71.6

Note: GP = general practitioner. (a) 1,319 GPs from 1,190 practices. Some practices had more than one GP participate during the study period. Excludes 17 GPs who did not provide responses about computer availability.

### **3.2.3 Computer use and clinical software use by individual GPs**

Of the 1,319 GPs who responded to the question about the availability of computers in their practice, 79 did not provide responses about their individual computer use. Of the 1,240 who did respond, 64 (5.2%) reported not using a computer, even though one was available at the practice. This figure, combined with the 6.0% of GPs having no computer at their practice, meant that 11.2% of the 1,319 responding GPs were not using a computer in their practice for any purpose.

The majority of GPs used a work computer for electronic prescribing (83.8%), ordering tests (72.7%) and keeping some or all patient data in medical records (70.3%). Just over half used email and slightly more used the Internet (Table 3.4). Six per cent of doctors with clinical software available at the practice reported not using the software. Most of these were internet and/or email users only.

### **3.2.4 Computer functions used by GPs at work**

Just over one third of GPs (37.1%) used the computer and clinical software for all five nominated functions. A further 16.1% used the computer for test ordering, prescribing and medical records, but did not use internet or email (Table 3.4).

**Table 3.4 Computer and software use by individual GPs at work**

	Number of GPs using computers and software for specific functions	Proportion (%) of all GPs with computers and software available (n=1,240) <sup>(a)</sup>	Proportion (%) of GPs who use computers and software (n=1,097) <sup>(b)</sup>
<b>Computer use</b>			
Computer not used at all	64	5.2	—
<b>Computer used for:</b>			
Test ordering	902	72.7	82.2
Prescribing	1,039	83.8	94.7
Medical records	872	70.3	79.5
Internet	732	59.0	66.7
Email	652	52.6	59.4
<b>Clinical software:</b>			
Available and used	1,040	83.9	93.4
Available but not used	74	6.0	6.6
<b>Use of clinical functions</b>			
Clinical functions not used at all <sup>(c)</sup>	143	11.5	—
All clinical functions used	460	37.1	41.9
Test ordering + prescribing + medical records	200	16.1	18.2
Test ordering + prescribing + medical records + Internet	83	6.7	7.6
Test ordering + prescribing	57	4.6	5.2
Test ordering + prescribing + Internet + email	45	3.6	4.1
Prescribing + medical records + Internet + email	44	3.5	4.0
Prescribing only	42	3.4	3.8
Internet + email	26	2.1	2.4
Prescribing + medical records	20	1.6	1.8

\* 1,114 respondents provided data on individual computer use, clinical functions and name of software.

(a) Excludes missing data from 79 GPs who did not provide responses on individual computer use.

(b) Excludes data from 79 GPs with no computer available and from 64 GPs who chose not to use available computers.

(c) Computer used for accounts, administration, Internet and/or email only.

### 3.2.5 Medical record follow-up questionnaire

Of the 872 GPs who had ticked the ‘medical record’ option on their GP profile (and were therefore subsequently posted the follow-up questionnaire, described in Figure 3.2), 687 (78.8%) returned completed forms. Four GPs responded that they were not computerised at all in their practice, even though the ‘medical record’ and or other components had clearly been ticked on the GP profile. These four were removed from the analyses, leaving 683 usable questionnaires.

As shown in Table 3.5, of the 683 respondents, just over half (52.1%) nominated the ‘fully computerised’ medical record option (Option 1). The ‘mostly computerised’ option (Option

2) was reported by 73 GPs (10.7%), and 37.2% reported being ‘partially computerised’ (Option 3).

**Table 3.5 Computerised medical record use**

	Number of GPs	Per cent of GPs with computerised medical records (n=872)	Per cent of GPs with computerised medical records who returned follow-up questionnaires (n=683) <sup>(a)</sup>
Questionnaires sent	872	100.0	—
Questionnaires returned*	683	78.3	100.0
Fully computerised (Option 1)	356	40.8	52.1
Mostly computerised (Option 2)	73	8.4	10.7
Partially computerised (Option 3)	254	29.1	37.2

(a) 687 follow-up questionnaires returned, 4 removed because of inconsistency = 683

### ***Partial use of computerised medical record software function***

Of the 254 GPs who indicated that they keep only some aspects of the patient’s information in the computerised medical record available through their clinical software (Option 3), the vast majority kept prescribing information (97.2%) although a much smaller proportion of these GPs (56.3%) kept a record of the problem for which the script had been provided. Similarly, while 85.8% reported noting tests ordered in the computerised medical record, only half of these (42.5%) recorded the problem for which the investigation was ordered. Fewer than half of the 254 partially computerised GPs (48.5%) kept the patient’s history in electronic format, and 61.4% kept a record of the current problems. Over two-thirds (69.3%) recorded referrals, and a high proportion (84.3%) kept details of immunisations in the medical recorded provided in their software (Table 3.6).

**Table 3.6 Partial computerised medical record use (Option 3)**

<b><i>Components used:</i></b>	Number of GPs	Per cent of GPs with partial record use (n=254)	Per cent of GPs with computerised medical records who returned follow-up questionnaires (n=683) <sup>(a)</sup>
Patient history	123	48.5	80.8
Current problems managed	156	61.4	85.2
Prescriptions	247	97.2	99.0
Problem for script	143	56.3	83.7
Tests ordered	218	85.8	94.7
Problem for test	108	42.5	78.6
Referrals	176	69.3	88.6
Immunisations	214	84.3	94.1

(a) Proportions in this column calculated by adding GPs with the nominated component from Option 3 to those using this component in the fully computerised (Option 1) and mostly computerised (Option 2) groups.

### ***Combinations of software functions used***

Table 3.7 shows the other software functions used by the GPs who reported being fully computerised in terms of patient medical records (i.e., Option 1). Of the 356 GPs who recorded this option, 234 (65.7%) reported that they also used all other clinical functions of their computer. After removing the 189 GPs who did not return their follow-up questionnaire, this proportion equates to 22.3% of the remaining 1,051 GPs with computers and software available (or 18.9% of the 1,240 with computers and software available), and 25.3% of the remaining 908 GPs who actually use their computer and the available clinical software (21.3% of the total 1,097).

**Table 3.7 Most common software function combinations used by GPs with fully computerised medical records**

<b>Software function</b>	<b>Number of GPs</b>	<b>Proportion (%) of GPs with fully computerised medical record (n=356)</b>	<b>Proportion (%) of all GPs with computers and software available (n=1,240)<sup>(a)</sup></b>		<b>Proportion (%) of GPs who use computers and software (n=1,097)<sup>(b)</sup></b>	
All 4 other functions used with fully computerised record	234	65.7	(22.3)*	18.9	(25.3)*	21.3
3 other functions used with fully computerised record	58	16.3	(5.5)*	4.7	(6.4)*	5.3
Test ordering + prescribing + Internet	35	9.8	(3.3)*	2.8	(3.3)*	3.2
Test order + prescribing + email	14	3.9	(1.3)*	1.1	(1.5)*	1.3
Prescribing + Internet + email	9	2.5	(0.9)*	0.7	(1.0)*	0.8
2 other functions used with fully computerised record	62	17.4	(5.9)*	5.0	(6.8)*	5.7
Test ordering + prescribing	61	17.1	(5.8)*	4.9	(6.7)*	5.6
Prescribing + email	1	0.3	(0.1)*	0.08	(0.1)*	0.09
1 other function used with fully computerised record	2	0.6	(0.2)*	0.2	(0.2)*	0.2

(a) Excludes missing data from 79 GPs who did not provide responses on individual computer use.

(b) Excludes data from 79 GPs with no computer available and from 64 GPs who chose not to use available computers. Excludes missing data from 189 GPs who did not return usable follow-up questionnaires about medical record use

### 3.2.6 GPs comments

Comments were received from 215 GPs (31.5%). There were an assortment of comments about cost and availability, for example:

‘the system is too expensive to maintain’

‘we aim for full computerisation but are limited by suppliers’

But comments were by and large associated with 3 themes. Examples are provided below:

#### *Quality*

‘some information is on computer but we still keep paper records due to not being able to be the typist as well as the doctor’

‘computer records make very poor clinical notes’

‘this has revolutionised my life as a GP with good quality and quickly retrievable accurate information’

‘fully computerised – that’s why doing your survey was a hassle’

‘in practice this is a very difficult system, much harder than paper’

‘computers were down for one day during BEACH so some information (records of consultation) was written into the old patient history (paper files) in those cases’

#### *Reliability*

‘fully computerised – great when system works – panic with down times but few and far between’

‘double records - ie paper records of patient history, treatment, referrals are noted on a card as well as kept on computer for back up in case of crashes’

‘a paper record is kept as well for all items listed’

‘we maintain hard copies of all information as the networked computers are inclined to still crash periodically’

#### *Practice policy vs individual choice*

The most recurring comment highlighted the absence of any structured practice policy, resulting in a situation where practices are keeping patient information in two formats – some information being stored on computer and some on paper – for the same patients in the same practice, depending on the decision of the individual doctors in the practice.

‘the only paper record I keep is for wound dressings and very occasional visitors – this only applies to me, not my partners’

‘some of the doctors in our practice only use computer – some only use paper notes. I use both’

‘my software can cope with prescriptions and referrals on its system but I prefer to do these with pen and paper’

‘all items are in both computer and paper record’

‘many patients have a mix of paper and computer records’

‘computer system has more potential but is not being used as practice policy has not changed’

‘basically I am old fashioned and use written clinical notes 90% of the time’

‘we are regarded as a paper record practice. Several doctors including myself keep a computer record & print out the record & add it to the paper file. Our computer system often fails making a true computer 'paperless' record impossible’

‘summary of patient history is kept on computer but not every visit’

‘not all doctors in our practice are paperless yet’

‘some doctors in the practice only use the computer for some of these functions’

‘one of the four doctors in our practice still writes his notes – the rest of us write an entry with date and diagnosis in the progress notes with reference to computer notes for the patient’

‘complex histories are still put on paper and other doctors in the practice use paper more than me’

‘mixed record keeping as different doctors at the clinic have different usage patterns’.

## **4 Practice behaviour of individual clinical computer users and non clinical computer users**

In Chapter 3 I examined the availability of computers at the major practice address of the GPs in this study sample, and how the clinical functions of the computer are used by individual GPs in their workplace. This Chapter investigates how individual GPs who use their computer in the performance of their clinical activities differ in their practice behaviour from GPs who do not use a computer for clinical activities.

**Hypothesis:** GPs who use a computer for clinical purposes will provide a ‘better’ standard of care than GPs who do not use a computer for clinical purposes.

**Rationale:** Based on literature reviewed from over the past two decades, the use of a computer is assumed to improve the performance of practitioners and patient outcomes.

### **4.1 Methods**

The methods utilised for this chapter are based on the BEACH methodology described in Chapter 2. As described in Chapter 3, the additional questions designed for the GP Profile questionnaire were used to investigate the clinical computer use of individual BEACH GPs (Figure 3.1).

#### **4.1.1 The participants**

From the results of the Chapter 3 investigation, I was able to determine individual computer use for 1,257 GPs. These 1,257 GPs were included in analyses for this Chapter. The GPs were assigned to two groups according to their self-reported use of a computer for clinical activity.

#### **Definitions**

*Clinical computer use* was defined as the use of a computer for clinical functions e.g. prescribing and/or test ordering and/or medical records, with or without internet and/or email.

*Non-clinical computer use* was defined as the use of a computer for administrative functions, internet and/or email only. Clinical components of the medical software application such as prescribing, test ordering, medical records, while were not utilised by the GP in his clinical practice.

The GPs who reported clinical computer use will be referred to in this Chapter as ‘clinical computerised GPs’ or ‘clinical computer users’. There were 1,069 GPs in this group. The GPs who reported non-clinical computer use, or did not use a computer at all, will be referred to in this Chapter as ‘non-clinical computerised GPs’ or ‘non-clinical computer users’. There were 188 GPs in this group.

#### **4.1.2 Statistical methods used in this Chapter**

The following results are reported in terms of the number of observations (n), proportions (%), rates per 100 encounters, rates per 100 problems managed, and the 95% confidence intervals. Chi square statistics were applied to the measurement of differences in GP characteristics.

#### **Descriptive analysis**

I have used the 95% confidence limits to report the results of univariate descriptive comparisons of GP characteristics other than individual computer use, their practice

characteristics, patient characteristics, patient reasons for the encounter (RFEs), the problems managed at the encounter, and their management activities. Where confidence intervals do not overlap, the difference between the two measures is regarded as significant. Chi squared statistics were applied to further measure the differences in GP and practice characteristics, as the chi squared test allows the measurement of differences within and between groups (e.g. GP age can be compared between computerised and non-computerised GPs over four different age ranges within each group). The descriptive analyses were performed using SAS version 8.2.(32) and results from these descriptive comparisons are presented in Tables 4.1 to 4.21.

## **Univariate analysis**

For a range of outcomes, univariate analyses were performed to determine significant associations between the individual outcome variable and the status of the GP regarding their use of a computer for clinical purposes. For these analyses, outcome variables with multiple categories were collapsed into dichotomous variables. For categorical outcome variables the results are reported as odds ratios with 95% CI and *P* values under the unadjusted column in Tables 4.22-4.33. GPs not using a computer for clinical purposes are the reference group, with an Odds Ratio of 1 for the outcome of interest in the comparisons with GPs using a computer for clinical purposes. Where the outcome variable is continuous, the regression coefficient is reported (Table 4.23).

STATA 8.2(37) was used for both univariate and multivariate analyses as reported in Tables 4.22-4.33.

## **Multivariate analysis and models used**

As described in Chapter 2 the step-wise backward elimination process was used to obtain the final models for GP and practice characteristics for patient outcomes (Model 4A), for patient morbidity outcomes (Model 4B), and management outcomes (Model 4C).

### ***Model 4A***

This model was applied to adjust for GP and practice characteristics where patient characteristics were the outcomes. As the base for this model was the sample of GPs, a simple random sample design and conventional modelling, without correcting for the cluster, was used to analyse these data. The variables showing some association ( $P < 0.10$ ) with the dependent variable (GP computer use for clinical purposes) in the simple logistic regression were included in the stepwise procedure for elimination and refitting of the model. These variables included: GP sex; GP age; place of graduation; consultations in a language other than English; GP status as a Fellow of the RACGP; work in a deputising service during the preceding 4 weeks; work in a residential aged care facility during the preceding 4 weeks; bulkbilling for all patients; size of practice; practice location by the Australian Standard Geographical Classification (ASGC)(40); practice location by the Socio-Economic Indexes for Areas (SEIFA)(41); practice location by state; practice accreditation status; presence of a practice nurse at the major practice address.

### ***Covariates in model 4A***

To improve precision, variables were tested at the 95% association level in the final model. The variables showing significant association ( $p < 0.05$ ) and included as covariates in the final model were: GP age; GP status as a Fellow of the RACGP; GP status as having worked in a deputising service in the preceding 4 weeks; GP status as having bulk billed for all patients; practice accreditation status; presence of a practice nurse at the major practice address. GP

sex was not significant at the 0.05 level in the final model, but previous research has demonstrated that medical conditions are managed differently by male and female GPs(42). Considering the possible effect on the problem management rate, I decided to retain GP sex in the final model.

### ***Model 4B***

This model was used for morbidity outcomes, to adjust for GP, practice and patient characteristics. As the base for this model was the sample of GP-patient encounters, a cluster sample design and modelling correcting for the cluster effect was used when Model 4B was applied.

### ***Covariates in Model 4B***

The variables included as covariates and adjusted for in the final model were: patient sex; patient age; patient status as a Commonwealth Health Care Benefits card holder; patient status as a Veterans' Affairs card holder; patient's Non-English speaking background status; patient's Aboriginal or Torres Strait Islander status; patient's status to the practice (i.e. new or seen previously); the GP and practice characteristics included in Model 4A.

### ***Model 4C***

The managements provided by the GP at the encounter were the comparisons for which this model was applied. As in Model 4B, the base for the model was the sample of GP-patient encounters, so the analysis was again based on a cluster sample design utilising modelling to correct for the cluster effect.

### ***Covariates in model 4C***

The GP, practice characteristics and patient characteristics included in Model 4B; the presence or absence of problems managed by ICPC-2 Chapter at the encounter.

### **Group variable of interest**

For all models, the group variable was GP clinical computer use. GPs not using a computer for clinical purposes comprised the reference group against which the group of GPs using a computer for clinical purposes was compared.

## 4.2 Results

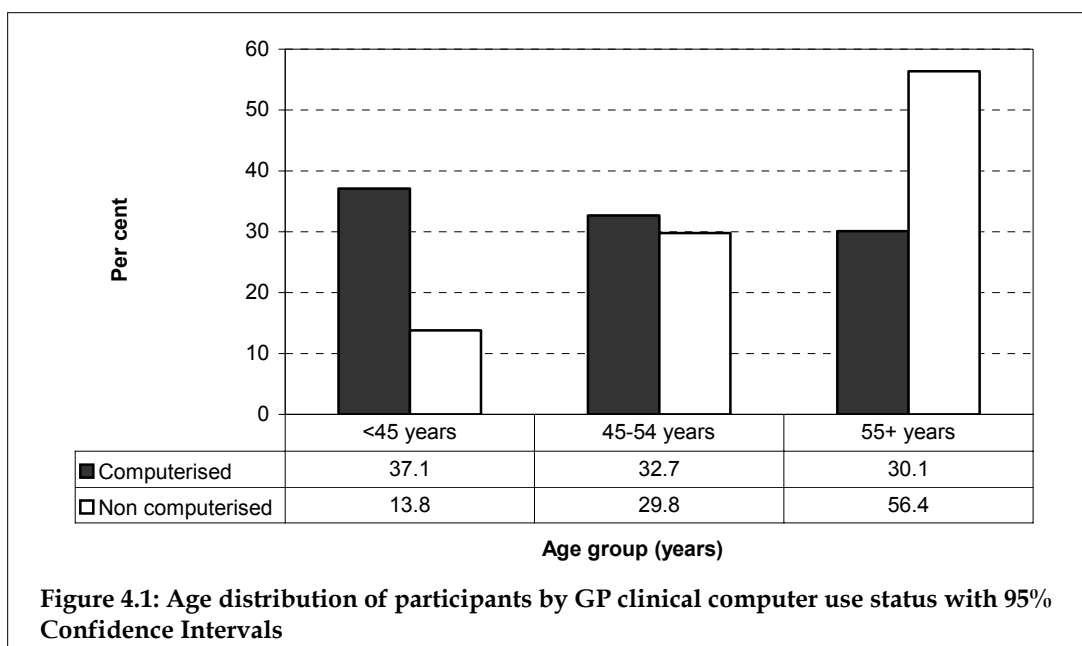
### 4.2.1 The GPs and their practices

As previously stated, responses to the questions designed for this study about individual computer use for clinical activity were provided by 1,257 (94.1%) of the total sample of GPs. For the remainder of this chapter, the GPs who reported using computers for clinical activity will be referred to as ‘clinical computer users’ and GPs not using computers for clinical activity (including in this instance those who do not use a computer at all) will be referred to as ‘non-clinical computer users’.

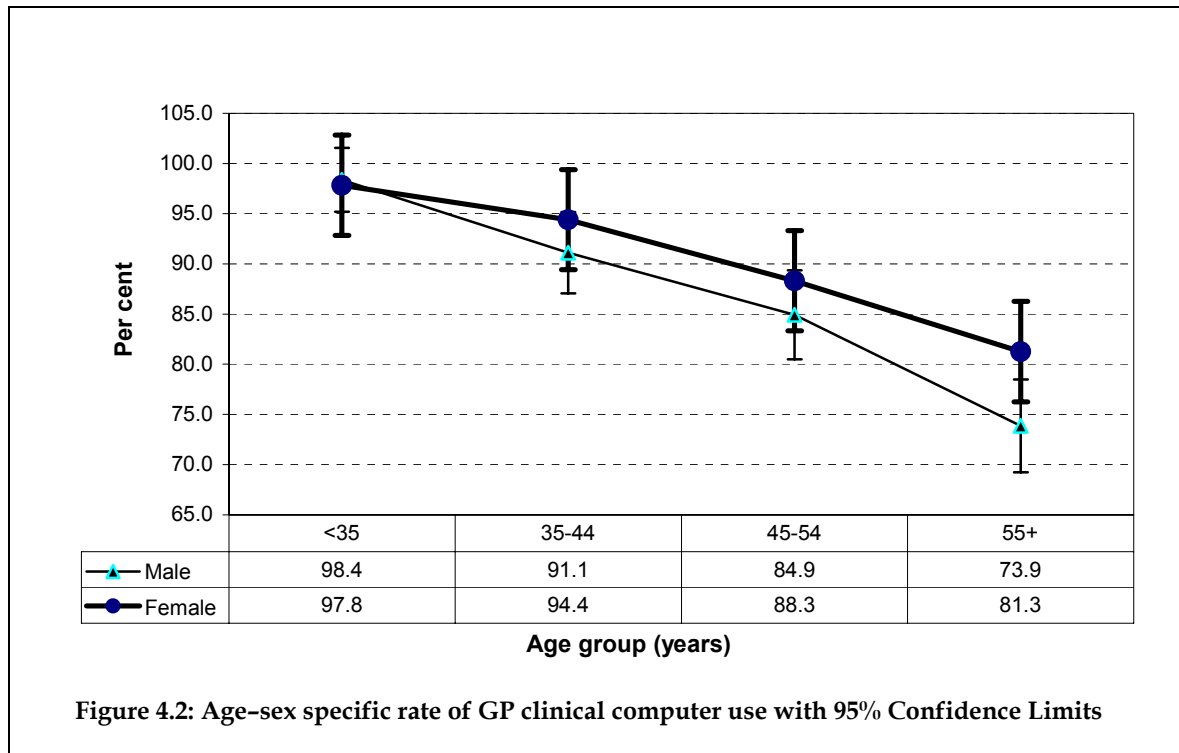
The characteristics of GPs using computers and those who don’t are compared in Table 4.1, with the characteristics of their practices compared in Table 4.3. Where the statistical comparison of means is appropriate (for continuous variables such as GP age, years in practice, size of practice, etc) these are presented in Table 4.2.

#### GP Age

There were significant differences in the age distribution of GP clinical computer users and non-clinical computer users. Clinical computer users were likely to be in the younger age group while non-users were predominantly in the group aged 55 years or older, as demonstrated in Figure 4.1 (tabulated with 95% confidence intervals in Table 4.1).



The age-sex specific rates of GPs using computers for clinical purposes are shown in Figure 4.2. Clinical computer use decreased with age for both male and female GPs. Almost all GPs aged less than 35 years used a computer for clinical purposes and this reduced to 82% of females and 74% of males in the 55 years and over age group.



## GP Sex

Table 4.1 shows that, overall, a greater proportion of clinical computer users were female (34.1%, 95% CI: 31.2-36.9) compared with non clinical computer users (21.8%, 95% CI: 15.9-27.7). Conversely, a greater proportion of non clinical computer users were male (78.2%, 95% CI: 72.3-84.1) compared to those who were clinical computer users (65.9%, 95% CI: 63.1-68.8).

## Other characteristics

When compared with non clinical computer users, GPs who used a computer for clinical purposes:

- were younger, with a mean age of 48.9 years compared with a mean of 55.3 years ( $p < 0.0001$ ) (Table 4.2) and in line with this difference in age:
  - had significantly fewer years in general practice, with a mean of 19.4 years compared with a mean of 25.8 years for non clinical computer users ( $p < 0.0001$ ) (Table 4.2)
  - were significantly more likely to have graduated more recently i.e. less than 20 years ago, and significantly less likely to have graduated 30 or more years ago ( $p < 0.001$ ) (Table 4.1)
- were more like to have graduated from their primary medical degree in Australia, and significantly less likely to have graduated overseas ( $p = 0.001$ ) (Table 4.1)
- were more than twice as likely to be Fellows of the RACGP than non clinical computer users ( $p < 0.001$ ) although there were larger proportions of non-Fellows than Fellows in both groups (Table 4.1)
- were only half as likely to bulkbill for all patients, and far more likely to bulkbill for selected patients only ( $p < 0.001$ ) (Table 4.1)
- worked in significantly larger practices, with the mean size of practice for clinical computer users being 5.9 GPs and the mean for non clinical computer users being 2.7 ( $p < 0.0001$ ) (Table 4.2). Clinical computer users were more likely to work in practices of 5 or more GPs (58.2%, 95% CI: 55.2-61.1) than non clinical computer users (22.3%, 95% CI: 16.4-28.3), while non computer users were more likely to be in solo practice: fewer than one in twelve clinical computer users were solo practitioners (7.9%, 95% CI: 6.3-9.5) compared with nearly one in three non clinical computer users (31.9%, 95% CI: 25.2-38.6) (Table 4.3)
- were less likely to practice in major cities (by ASGC) ( $p = 0.001$ ), or in metropolitan areas (by RRMA) ( $p = 0.0002$ ) than non clinical computer users (Table 4.3)
- were more than twice as likely to work in an accredited practice than non clinical computer users ( $p < 0.001$ ) (Table 4.3)
- were three times as likely to have a practice nurse at their major practice address ( $p < 0.001$ ) (Table 4.3).

**Table 4.1: Characteristics of the GPs**

GP characteristic	GPs using a computer for clinical purposes				GPs not using a computer for clinical purposes			
	Number <sup>(a)</sup>	Per cent of GPs <sup>(a)</sup> (n=1,069)	95% LCL	95% UCL	Number <sup>(a)</sup>	Per cent of GPs <sup>(a)</sup> (n=188)	95% LCL	95% UCL
Sex ( $\chi^2=11.0$ , p=0.001)								
(Missing)	(0)				(0)			
Male	705	65.9	63.1	68.8	147	78.2	72.3	84.1
Female	364	34.1	31.2	36.9	41	21.8	15.9	27.7
Age ( $\chi^2=58.6$ , p<0.001)								
(Missing)	(0)				(0)			
<45 years	397	37.1	34.2	40.0	26	13.8	8.9	18.8
45-54 years	350	32.7	29.9	35.6	56	29.8	23.2	36.3
55+ years	322	30.1	27.4	32.9	106	56.4	49.3	63.5
Years in general practice ( $\chi^2=38.0$ , p<0.001)								
(Missing)	(5)				(1)			
<10 years	206	19.4	17.0	21.7	11	5.9	2.5	9.3
10-19 year	337	31.7	28.9	34.5	41	21.9	16.0	27.9
20+ years	521	49.0	46.0	52.0	135	72.2	65.8	78.6
Country of graduation ( $\chi^2=11.2$ , p=0.001)								
(Missing)	(0)				(0)			
Australia	792	74.1	71.5	76.7	117	62.2	55.3	69.2
Overseas	277	25.9	23.3	28.5	71	37.8	30.8	44.7
Years since graduation ( $\chi^2=53.8$ , p<0.001)								
(Missing)	(4)				(1)			
<20 years	365	34.3	31.4	37.1	31	16.6	11.2	21.9
20-29 years	392	36.8	33.9	39.7	52	27.8	21.4	34.2
30+ years	308	28.9	26.2	31.6	104	55.6	48.5	62.7
Any NESB consultations ( $\chi^2=4.2$ , p=0.04)								
(Missing)	(2)				(1)			
Yes	261	24.5	21.9	27.0	59	31.6	24.9	38.2
No	806	75.5	73.0	78.1	128	68.4	61.8	75.1
GP registrar ( $\chi^2=1.4$ , p=0.23)								
(Missing)	(11)				(3)			
Yes	42	4.0	2.8	5.1	4	2.2	0.1	4.3
No	1016	96.0	94.9	97.2	181	97.8	95.7	99.9

(continued)

**Table 4.1 (continued): Characteristics of the GPs**

GP characteristic	GPs using a computer for clinical purposes				GPs not using a computer for clinical purposes			
	Number <sup>(a)</sup>	Per cent of GPs <sup>(a)</sup> (n=1,069)	95% LCL	95% UCL	Number <sup>(a)</sup>	Per cent of GPs <sup>(a)</sup> (n=188)	95% LCL	95% UCL
DVA registered ( $\chi^2=1.8$ , p=0.18)								
(Missing)	(24)				(4)			
Yes	943	90.2	88.4	92.0	160	87.0	82.1	91.8
No	102	9.8	8.0	11.6	24	13.0	8.2	17.9
FRACGP status ( $\chi^2=37.4$ , p<0.001)								
(Missing)	(10)				(3)			
Yes	465	43.9	40.9	46.9	37	20.0	14.2	25.8
No	594	56.1	53.1	59.1	148	80.0	74.2	85.8
Sessions per week ( $\chi^2=1.1$ , p=0.57)								
(Missing)	(7)				(1)			
<6 per week	162	15.3	13.1	17.4	33	17.6	12.2	23.1
6-10 per week	772	72.7	70.0	75.4	129	69.0	62.3	75.6
11+ per week	128	12.1	10.1	14.0	25	13.4	8.5	18.3
Direct patient care hours per week ( $\chi^2=2.2$ , p=0.54)								
(Missing)	(31)				(4)			
0-30 hours	263	25.3	22.7	28.0	43	23.4	17.2	29.5
31-40 hours	329	31.7	28.9	34.5	64	34.8	27.9	41.7
41-50 hours	287	27.6	24.9	30.4	55	29.9	23.3	36.5
51+ hours	159	15.3	13.1	17.5	22	12.0	7.3	16.7
Bulk billing status ( $\chi^2=66.1$ , p<0.001)								
(Missing)	(4)				(0)			
Bulkbill for all patients	253	23.8	21.2	26.3	99	52.7	45.5	59.8
Do not bulkbill for all patients	812	76.2	73.7	78.8	89	47.3	40.2	54.5
Work in past four weeks: As a locum ( $\chi^2=0.7$ , p=0.42)								
(Missing)	(2)				(0)			
Yes	58	5.4	4.1	6.8	13	6.9	3.3	10.5
No	1009	94.6	93.2	95.9	175	93.1	89.5	96.7

(continued)

**Table 4.1 (continued): Characteristics of the GPs**

GP characteristic	GPs using a computer for clinical purposes				GPs not using a computer for clinical purposes			
	Number <sup>(a)</sup>	Per cent of GPs <sup>(a)</sup> (n=1,069)	95% LCL	95% UCL	Number <sup>(a)</sup>	Per cent of GPs <sup>(a)</sup> (n=188)	95% LCL	95% UCL
In a deputising service (Missing)								
( $\chi^2=5.2, p=0.02$ )	(2)				(0)			
Yes	25	2.3	1.4	3.3	10	5.3	2.1	8.5
No	1042	97.7	96.7	98.6	178	94.7	91.5	97.9
In a residential aged care facility (Missing)								
( $\chi^2=4.9, p=0.03$ )	(0)				(0)			
Yes	531	49.7	46.7	52.7	77	41.0	33.9	48.0
No	538	50.3	47.3	53.3	111	59.0	52.0	66.1
As a salaried/ sessional hospital medical officer (Missing)								
( $\chi^2=4.1, p=0.04$ )	(2)				(0)			
Yes	135	12.7	10.7	14.6	14	7.4	3.7	11.2
No	932	87.3	85.4	89.3	174	92.6	88.8	96.3

(a) Missing data removed.

Note: UCL—upper confidence limit; LCL— lower confidence limit. Shading indicates statistically significant differences between two groups of GPs. ACCHS = Aboriginal Community Controlled Health Service

**Table 4.2: Comparison of means for continuous GP/practice variables**

GP/practice variable	GPs using a computer for clinical purposes				GPs not using a computer for clinical purposes				P value
	Number <sup>(a)</sup>	Mean	95% LCL	95% UCL	Number <sup>(a)</sup>	Mean	95% LCL	95% UCL	
Age (year)	1,069	48.9	48.3	49.6	188	56.9	55.3	58.5	<0.0001
Years in practice	1,064	19.4	18.7	20.0	187	25.8	24.3	27.4	<0.0001
Sessions per week	1,062	8.3	8.1	8.4	187	8.4	8.0	8.7	0.63
Size of practice (number of GPs in the practice)	1,061	5.9	5.7	6.1	188	3.4	2.7	4.0	<0.0001
Direct patient care hours	1,038	39.8	39.0	40.6	184	40.2	38.4	42.1	0.67

(a) Missing data removed.

Note: UCL—upper confidence limit; LCL— lower confidence limit. Shading indicates statistically significant differences between two groups of GPs.

**Table 4.3: Characteristics of GPs' practice**

Practice characteristic	GPs using a computer for clinical purposes				GPs not using a computer for clinical purposes			
	Number <sup>(a)</sup>	Per cent of GPs <sup>(a)</sup> (n=1,069)	95% LCL	95% UCL	Number <sup>(a)</sup>	Per cent of GPs <sup>(a)</sup> (n=188)	95% LCL	95% UCL
Size of practice ( $\chi^2=124.8$ , p<0.001)								
(Missing)	(8)				(0)			
Solo	84	7.9	6.3	9.5	60	31.9	25.2	38.6
2–4 GPs	360	33.9	31.1	36.8	86	45.7	38.6	52.9
5+ GPs	617	58.2	55.2	61.1	42	22.3	16.4	28.3
Practice location by ASGC ( $\chi^2=11.2$ , p=0.001)								
(Missing)	(3)				(0)			
Major city	689	64.6	61.8	67.5	145	77.1	71.1	83.1
Not in Major city	377	35.4	32.5	38.2	43	22.9	16.9	28.9
Practice location by RRMA ( $\chi^2=14.2$ , p=0.0002)								
(Missing)	(1)				(0)			
Metropolitan	736	68.9	66.1	71.7	155	82.4	77.0	87.9
Not in metropolitan	332	31.1	28.3	33.9	33	17.6	12.1	23.0
Practice location by SEIFA ( $\chi^2=4.61$ , p= 0.03)								
(Missing)	(12)				(3)			
Disadvantage SEIFA (<4)	253	23.9	21.4	26.5	58	31.4	24.7	38.0
Less disadvantage SEIFA (4-11)	804	76.1	73.5	78.6	127	68.6	62.0	75.3
Accreditation status ( $\chi^2=259.6$ , p<0.001)								
(Missing)	(9)				(1)			
Yes	949	89.5	87.7	91.4	76	40.6	33.6	47.7
No	111	10.5	8.6	12.3	111	59.4	52.3	66.4
Practice nurse at major practice ( $\chi^2=122.9$ , p<0.001)								
(Missing)	(6)				(2)			
Yes	700	65.9	63.0	68.7	42	22.6	16.6	28.6
No	363	34.1	31.3	37.0	144	77.4	71.4	83.4

(a) Missing data removed.

Note: UCL–upper confidence limit; LCL– lower confidence limit; ASGC = Australian Standard Geographical Classification; RRMA = Rural, Remote and Metropolitan Areas; SEIFA = Socio-Economic Indexes for Areas. Shading indicates statistically significant differences between two groups of GPs.

## Consultation length

As previously reported, the GPs noted the starting time and finishing time for 40 of their 100 patient encounters. The average length of direct consultations (patient seen at the encounter) (A1 items of service only) was calculated on the basis of the recorded start time subtracted from the recorded finish time for these 40 encounters. The mean length of consultation for clinical computer users and non clinical computer users is compared in Table 4.4. There was no significant difference between the two groups: the mean length of consultation being 15 minutes, the median being 14 minutes, and the mode, 10 minutes.

**Table 4.4: Consultation length by GPs using computer for clinical purpose status**

Statistical measures – minute	GPs using computer for clinical purpose (n=34,633)			GPs not using computer for clinical purpose (n=6,084)		
	Mean	95% LCL for mean	95% UCL for mean	Mean	95% LCL for mean	95% UCL for mean
Mean	15.0	14.8	15.3	15.0	14.2	15.7
Median	13.0	—	—	13.0	—	—
Mode	10.0	—	—	10.0	—	—

Note: Missing data removed. The start and finish times were recorded for 40 of the 100 encounters. The length of consultation in minutes is finish time minus start time. The encounters marked by the GP as claimable for payment through the Medicare system as a General Practitioner Attendance item were included in this analysis. CL—confidence limit.

### 4.2.2 Characteristics of encounters by GP clinical computer use status

Table 4.5 shows the distribution of the encounters recorded by clinical computer users and non clinical computer users. There were no significant differences in the proportions of encounters reported as claimable from Medicare, through Workers' Compensation or from other sources. There were also no differences in the proportions of encounters classified as indirect (where the patient was not seen but a service was provided). However, there was a significant difference in the proportion of encounters recorded as home visits – clinical computer users provided significantly fewer home visits (proportionally less than half) than non clinical computer users (0.9%, 95% CI: 0.7-1.1 cf. 2.3%, 95% CI: 1.4-3.2).

**Table 4.5: Distribution of services by GP computer use status**

Variable	GPs using a computer for clinical purposes				GPs not using a computer for clinical purposes			
	Number <sup>(a)</sup>	Per cent of encounters <sup>(a)</sup> (n=106,900)	95% LCL	95% UCL	Number <sup>(a)</sup>	Per cent of encounters <sup>(a)</sup> (n=18,800)	95% LCL	95% UCL
Direct consultations	96,084	96.9	96.6	97.2	16,999	97.3	96.5	98.1
No charge	544	0.5	0.5	0.6	124	0.7	0.3	1.1
Medicare paid	92,431	93.2	92.8	93.7	16,424	94.0	92.9	95.1
Short surgery consultations	974	1.0	0.8	1.2	177	1.0	0.5	1.5
Standard surgery consults	73,579	74.2	73.2	75.2	12,625	72.2	68.8	75.7
Long surgery consults	12,063	12.2	11.5	12.8	1,864	10.7	8.8	12.6
Prolonged surgery consults	968	1.0	0.8	1.2	194	1.1	0.5	1.7
Home visits	897	0.9	0.7	1.1	400	2.3	1.4	3.2
Hospitals	299	0.3	0.2	0.4	70	0.4	0.0	0.8
Nursing home	1,139	1.1	0.9	1.4	272	1.6	0.6	2.5
Other items	2,512	2.5	2.2	2.9	822	4.7	2.5	6.9
Worker's compensation	2,275	2.3	2.1	2.5	343	2.0	1.5	2.4
Other paid (hospital, state etc)	834	0.8	0.7	1.0	108	0.6	0.3	0.9
Indirect consults	3,069	3.1	2.8	3.4	479	2.7	1.9	3.5
Missing	7,747				1,322	.	.	.

(a) Missing data removed.

Note: Shading indicates statistically significant differences between groups. UCL–upper confidence limit; LC– lower confidence limit

#### 4.2.3 The content of encounters by GP clinical computer use status

Table 4.6 shows that compared with encounters with non-clinical computerised GPs, those with clinical computer users involved:

- a significantly higher rate of problems managed (150.0 cf. 144.1 per 100 encounters)
- a significantly lower prescribed medication rate (81.9 cf. 89.8 per 100 encounters)
- a significantly higher rate of pathology tests ordered (41.6 cf. 32.6 per 100 encounters).

**Table 4.6: Summary of morbidity and management**

Variables	GPs using computer for clinical purpose							GPs not using computer for clinical purpose						
	Number	Rate per 100 encounters (n=106,900)	95% LCL	95% UCL	Rate per 100 problems (n=160,905)	95% LCL	95% UCL	Number	Rate per 100 encounters (n=18,800)	95% LCL	95% UCL	Rate per 100 problems (n=27,091)	95% LCL	95% UCL
General practitioners	1,069	—	—	—	—	—	—	188	—	—	—	—	—	—
Encounters	106,900	—	—	—	—	—	—	18,800	—	—	—	—	—	—
Reasons for encounter	161,059	150.7	149.2	152.1	—	—	—	28,224	150.1	146.0	154.3	—	—	—
Problems managed	160,905	150.5	148.8	152.2	—	—	—	27,091	144.1	140.1	148.1	—	—	—
New problem	59,561	55.72	54.6	56.9	—	—	—	9,952	52.9	50.0	55.9	—	—	—
Old problem	101,344	94.8	93.0	96.6	—	—	—	17,139	91.2	86.7	95.7	—	—	—
Chronic problem	55,172	51.61	50.2	53.0	—	—	—	10,238	54.5	50.7	58.2	—	—	—
Medications	107,639	100.7	98.8	102.6	66.9	65.8	68.0	20,515	109.1	102.6	115.6	75.7	71.6	79.8
Prescribed	87,529	81.88	80.1	83.7	54.4	53.3	55.5	16,889	89.8	83.9	95.7	62.3	58.6	66.1
Advised OTC	10,081	9.43	8.9	10.0	6.3	5.9	6.6	1,958	10.4	8.1	12.8	7.2	5.6	8.8
GP-supplied	10,029	9.38	8.6	10.2	6.2	5.7	6.8	1,668	8.9	5.8	11.9	6.2	4.0	8.3
Other treatments	61,316	57.3	55.3	59.5	38.1	36.8	39.4	1,012	58.6	52.6	64.5	40.7	36.7	44.6
Clinical	42,485	39.74	37.9	41.5	26.4	25.3	27.5	7,547	40.1	35.4	44.9	27.9	24.8	30.9
Procedural	18,831	17.62	16.9	18.3	11.7	11.2	12.2	3,465	18.4	15.7	21.2	12.8	10.8	14.7
Referrals	13,360	12.5	12.1	12.9	8.3	8.0	8.6	2,198	11.7	10.5	12.8	8.1	7.4	8.9
Allied health services	3,184	3.0	2.8	3.1	2.0	1.9	2.1	507	2.7	2.2	3.2	1.9	1.5	2.2
Specialist	8,886	8.3	8.0	8.6	5.5	5.3	5.7	1,406	7.5	6.7	8.3	5.2	4.7	5.7
Emergency dept	161	0.2	0.1	0.2	0.1	0.1	0.1	38	0.2	0.1	0.3	0.1	0.1	0.2

(continued)

**Table 4.6 (continued): Summary of morbidity and management**

Variables	GPs using computer for clinical purpose							GPs not using computer for clinical purpose						
	Number	Rate per 100 encounters (n=106,900)	95% LCL	95% UCL	Rate per 100 problems (n=160,905)	95% LCL	95% UCL	Number	Rate per 100 encounters (n=18,800)	95% LCL	95% UCL	Rate per 100 problems (n=27,091)	95% LCL	95% UCL
Hospital	597	0.6	0.5	0.7	0.4	0.3	0.4	137	0.7	0.5	1.0	0.5	0.3	0.7
Referral NOS	532	0.5	0.4	0.6	0.3	0.3	0.4	110	0.6	0.3	0.9	0.4	0.2	0.6
Pathology	44,439	41.6	40.2	43.0	27.6	26.8	28.5	6,131	32.6	146.0	36.5	22.6	20.1	25.2
Imaging	9,214	8.6	8.3	8.9	5.7	5.5	5.9	1,537	8.2	140.1	9.1	5.7	5.0	6.3
Other investigation	1,201	1.1	1.0	1.2	0.8	0.7	0.8	169	0.9	50.0	1.1	0.6	0.5	0.8

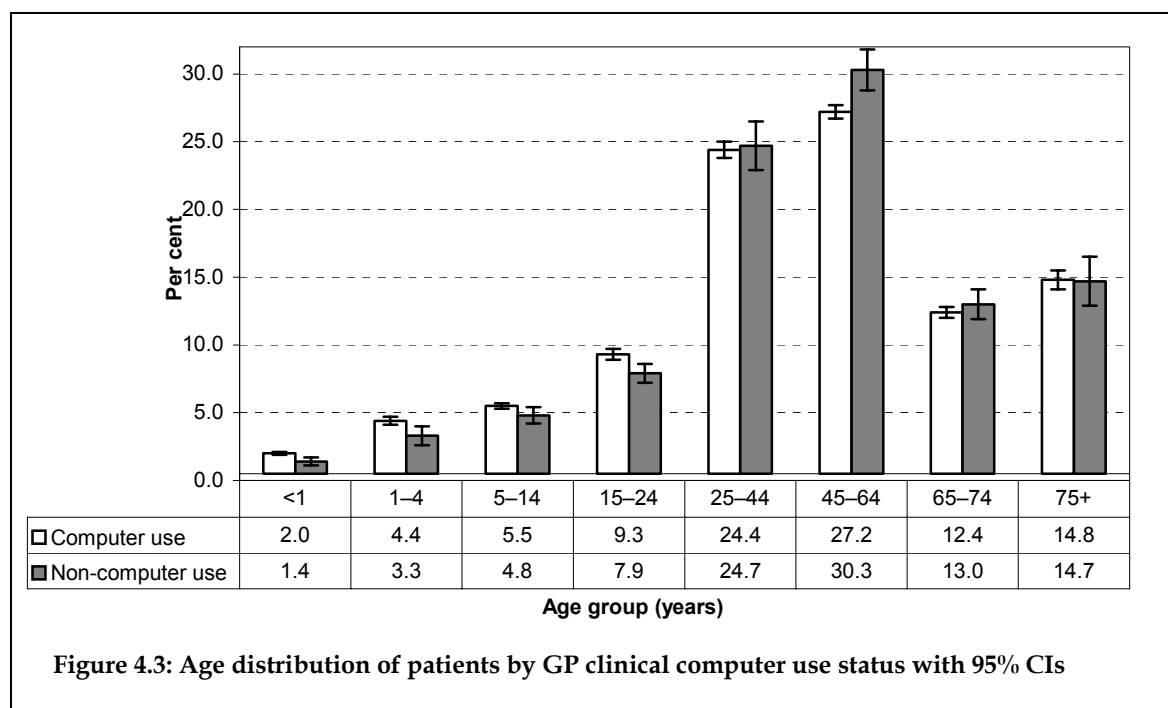
Note: UCL–upper confidence limit; LCL– lower confidence limit. Shading indicates statistically significant differences between groups.

#### 4.2.4 Patient characteristics by GP clinical computer use status

The patients at encounters with clinical computerised GPs differed markedly in several areas to those encountered by non-clinical computerised GPs.

##### Patient age

Clinical computer users saw proportionally more patients in the younger age groups up to 24 years (other than the 5-14 years group) and proportionally fewer patients aged 45-64 years. There were no significant differences between the two groups for patients aged 25-44 years, those aged 65-74 years, or 75 years and older. The age distribution of patients in the two groups is presented graphically in Figure 4.3.



##### Patient sex

A significantly larger proportion of the patients seen by clinical computer users were female (59.0, 95% CI: 58.2-59.8) compared to those seen by non-clinical/ non-computerised GPs (54.8, 95% CI: 53.0-56.7) (Table 4.7).

## Other patient characteristics

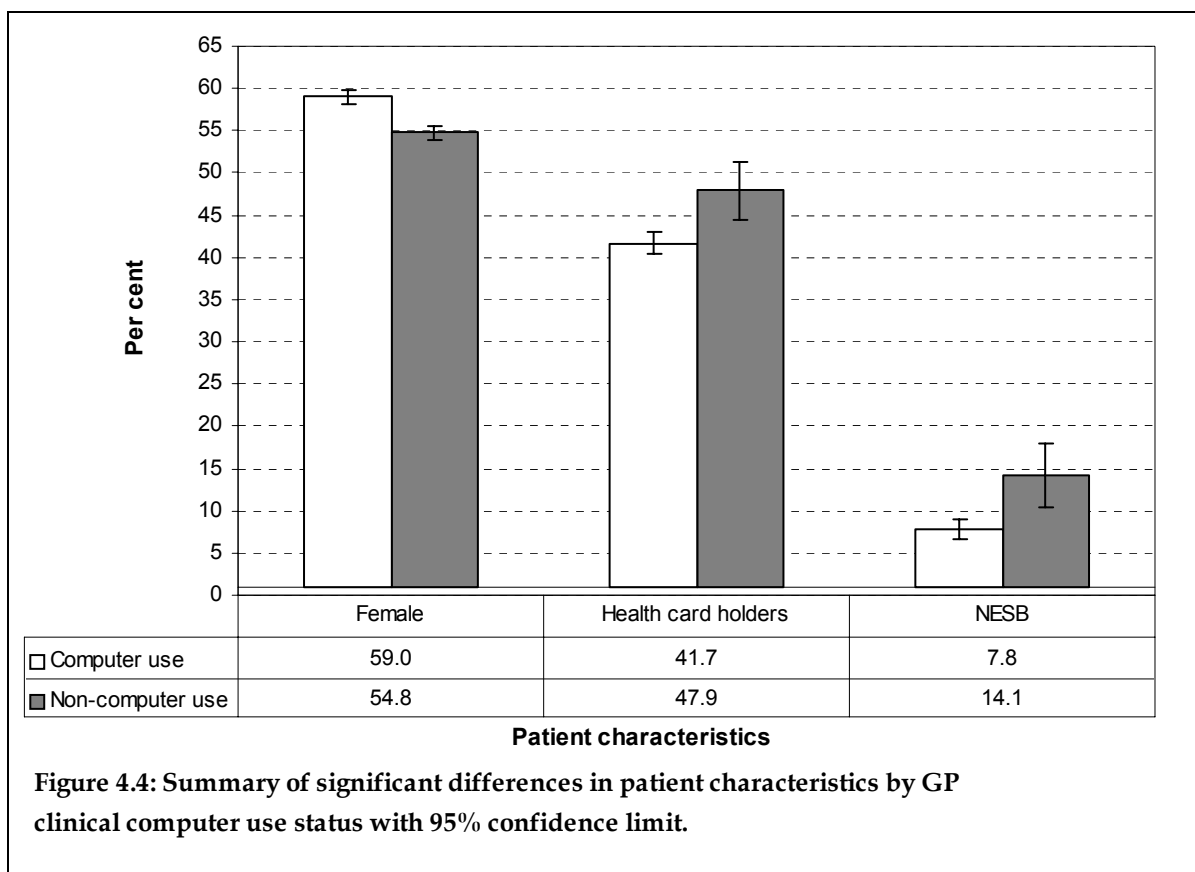
A significantly smaller proportion of patients seen by clinical computer users were Commonwealth Health Care Benefits card holders (41.7, 95% CI: 40.5-42.9 cf. 47.9, 95% CI: 44.5-51.2) and fewer were from a non-English speaking background (7.0, 95% CI: 6.0-8.0 cf. 12.8, 95% CI: 9.4-13.3). Figure 4.4 shows a graphic summary of the significant differences described above.

**Table 4.7: Characteristics of patients at encounters**

Patient variable	GPs using a computer for clinical purposes				GPs not using a computer for clinical purposes			
	Number	Percent of encounters (n=106,900)	95% LCL	95% UCL	Number	Percent of encounters (n=18,800)	95% LCL	95% UCL
<b>Sex</b>								
Males	43,429	41.0	40.2	41.8	8,398	45.2	43.3	47.0
Females	62,501	59.0	58.2	59.8	10,189	54.8	53.0	56.7
Missing sex	970				213			
<b>Age</b>								
<1 year	2,138	2.0	1.9	2.2	259	1.4	1.1	1.7
1-4 years	4,602	4.4	4.1	4.6	609	3.3	2.6	4.0
5-14 years	5,849	5.5	5.3	5.8	896	4.8	4.2	5.4
15-24 years	9,829	9.3	8.9	9.7	1,476	7.9	7.2	8.7
25-44 years	25,873	24.4	23.8	25.1	4,584	24.7	22.9	26.4
45-64 years	28,746	27.2	26.7	27.6	5,631	30.3	28.8	31.7
65-74 years	13,159	12.4	12.0	12.8	2,414	13.0	11.9	14.1
75+ years	15,663	14.8	14.1	15.5	2,726	14.7	12.9	16.4
Missing age	1,041				205			
<b>Other characteristics</b>								
C'wealth conc. card	44,599	41.7	40.5	42.9	8,996	47.9	44.5	51.2
VA card holder	3,874	3.6	3.4	3.9	599	3.2	2.6	3.8
NESB	7,500	7.0	6.0	8.0	2,409	12.8	9.4	16.3
Aboriginal	2,013	1.9	1.3	2.5	373	2.0	0.5	3.5
Torres Strait Islander	160	0.1	0.1	0.2	112	0.6	0.0	1.5
Aboriginal & Torres Strait Islander	56	0.1	0.0	0.1	14	0.1	0.0	0.1
Aboriginal and/or Torres Strait Islander	2,229	2.1	1.5	2.7	499	2.7	0.9	4.4
New to practice	9,776	9.1	8.5	9.7	2,177	11.6	9.4	13.8

(a) Missing data removed.

Note: Shading indicates statistically significant differences between groups. UCL–upper confidence limit; LCL– lower confidence limit. C'wealth conc. card = Health care/benefits card.



#### 4.2.5 Patient reasons for encounter by GP clinical computer use status

The patient's reasons for the encounter (RFE) are those problems or concerns given by the patient for why they've consulted the GP. GPs were asked to record up to three reasons given by the patient for the visit, as closely as possible to the words used by the patient. Each reason could be expressed as a symptom (e.g. 'sore ankle'), in diagnostic terms (e.g. 'about my asthma'), as a request for a service (e.g. 'I need another script' or 'I need a medical certificate'), an expressed fear or concern ('worried about cancer), or the need for a check-up.(43)

The patient's reason for the encounter has a one-to-many, many-to-one, or many-to-many relationship to the problem or problems managed, in that they may describe several symptoms that relate to the same problem, or may offer only one reason that may relate to several problems. Patient RFEs reflect the patient's demand for care and can provide information about service utilisation patterns.

There were no significant differences between the clinical computer users and non clinical computer users in terms of the distribution of number of RFEs recorded. In each group, approximately 60% reported one RFE, 27% reported two RFEs and 11% reported three RFEs (Table 4.8).

**Table 4.8: Number of patient reasons for encounter (RFEs)**

Number of reasons for encounter (n=161,059)	GPs using a computer for clinical purposes				GPs not using a computer for clinical purposes			
	Number	Per cent of encounters (n=106,900)	95% LCL	95% UCL	Number	Per cent of encounters (n=18,800)	95% LCL	95% UCL
One RFE	65,005	60.8	60.5	61.1	11,556	61.5	60.8	62.2
Two RFEs	29,631	27.7	27.5	28.0	5,064	26.9	26.3	27.6
Three RFEs	12,264	11.5	11.3	11.7	2,180	11.6	11.1	12.1
<b>Total</b>	<b>106,900</b>	<b>100.0</b>	<b>—</b>	<b>—</b>	<b>18,800</b>	<b>100.0</b>	<b>—</b>	<b>—</b>

Note: Shading indicates statistically significant differences between groups. UCL—upper confidence limit; LCL— lower confidence limit.

### Distribution of RFEs by ICPC-2 chapter by GP clinical computer use status

The distribution of RFEs as classified by ICPC-2 chapter (see Methods, Chapter 2) showed some significant differences between the two GP groups (Table 4.9).

Patients at encounters with clinical computer users expressed significantly more reasons for the encounter that were of a general or unspecified nature (38.5 per 100 encounters, 95% CI: 37.6-39.4 cf. 33.7, 95% CI: 31.2-36.2) or were associated with the female genital system (6.1 per 100 encounters, 95% CI: 5.7-6.6 cf. 4.6, 95% CI: 3.5-5.6), and significantly fewer problems associated with the circulatory system (10.0 per 100 encounters, 95% CI: 9.6-10.4 cf. 12.6, 95% CI: 11.0-13.7). For pregnancy and family planning, there was a marginal but not significant difference (confidence intervals touch but do not overlap) with the trend showing fewer of these for non clinical computer users.

There were no significant differences in the rates of reasons for encounter associated with the respiratory, skin, musculoskeletal, digestive, psychological, endocrine and metabolic, neurological, ear, pregnancy and family planning, eye, urological, blood, or male genital systems, or problems of a social nature.

**Table 4.9: Distribution of patient reasons for encounter by ICPC-2 chapter**

Reasons for encounter	GPs using a computer for clinical purposes				GPs not using a computer for clinical purposes			
	Number	Rate per 100 encounters (n=106,900)	95% LCL	95% UCL	Number	Rate per 100 encounters (n=18,800)	95% LCL	95% UCL
General & unspecified	41,171	38.5	37.6	39.4	6,336	33.7	31.2	36.2
Respiratory	20,148	18.9	18.2	19.5	3,525	18.8	17.1	20.4
Skin	17,257	16.1	15.5	16.8	3,087	16.4	13.9	19.0
Musculoskeletal	16,882	15.8	15.3	16.2	3,294	17.5	15.8	19.3
Circulatory	10,719	10.0	9.6	10.4	2,322	12.4	11.0	13.7
Digestive	10,406	9.7	9.4	10.0	1,966	10.5	9.5	11.4
Psychological	8,391	7.9	7.5	8.2	1,583	8.4	7.3	9.5
Female genital system	6,557	6.1	5.7	6.6	855	4.6	3.5	5.6
Endocrine & metabolic	6,518	6.1	5.8	6.4	1,257	6.7	5.7	7.7
Neurological	5,211	4.9	4.7	5.1	1,064	5.7	5.0	6.4
Ear	4,268	4.0	3.8	4.2	733	3.9	2.9	4.9
Pregnancy & family planning	4,263	4.0	3.7	4.2	543	2.9	2.0	3.7
Eye	2,810	2.6	2.5	2.8	499	2.7	2.3	3.0
Urology	2,723	2.6	2.4	2.7	462	2.5	2.1	2.8
Blood	1,402	1.3	1.2	1.5	244	1.3	1.0	1.6
Male genital system	1,178	1.1	1.0	1.2	261	1.4	0.8	2.0
Social	1,155	1.1	1.0	1.2	193	1.0	0.8	1.3
<b>Total RFEs</b>	<b>161,059</b>	<b>150.7</b>	<b>149.2</b>	<b>152.1</b>	<b>28,224</b>	<b>150.1</b>	<b>146.0</b>	<b>154.3</b>

Note: Shading indicates statistically significant differences between groups. UCL–upper confidence limit; LCL– lower confidence limit

### The most frequent individual patient RFEs by GP clinical computer use status

Table 4.10 shows the most commonly reported patient RFEs at a more specific level. Patients attending a clinical computer user were more likely to attend for test results (7.0 per 100 encounters, 95% CI: 6.7-7.4 cf. 5.4, 95% CI: 4.6-6.2), or for preventive immunisations/vaccinations (5.0 per 100 encounters, 95% CI: 4.6-5.4 cf. 3.3, 95% CI: 2.4-4.2), and less likely to attend for hypertension management (1.6 per 100 encounters, 95% CI: 1.4-1.8 cf. 2.5, 95% CI: 1.9-3.1). Requests for general check-up and female genital check-up were marginally more common at encounters with clinical computer users, and presentations of headache marginally less common than at encounters with non clinical computer users.

**Table 4.10: Most frequent individual patient reasons for encounter**

Reasons for encounter	GPs using a computer for clinical purposes				GPs not using a computer for clinical purposes			
	Number	Rate per 100 encounters (n=106,900)	95% LCL	95% UCL	Number	Rate per 100 encounters (n=18,800)	95% LCL	95% UCL
Prescription all*	13,363	12.5	12.0	13.0	2,549	13.6	11.7	15.4
Test results*	7,515	7.0	6.7	7.4	1,010	5.4	4.6	6.2
Cough	5,370	5.0	4.8	5.3	958	5.1	4.5	5.7
Preventive immun/vacc/meds-all*	5,326	5.0	4.6	5.4	625	3.3	2.4	4.2
Cardiac check-up*	4,976	4.7	4.4	4.9	973	5.2	4.4	6.0
General check-up*	4,193	3.9	3.7	4.1	594	3.2	2.6	3.7
Back complaint*	3,362	3.1	3.0	3.3	708	3.8	3.2	4.3
Throat complaint	3,150	3.0	2.8	3.1	632	3.4	2.8	3.9
Rash*	3,039	2.8	2.7	3.0	531	2.8	2.4	3.3
Female genital check-up*	2,636	2.5	2.2	2.7	297	1.6	1.0	2.2
Depression*	2,129	2.0	1.9	2.1	362	1.9	1.6	2.3
Abdominal pain*	1,938	1.8	1.7	1.9	347	1.9	1.6	2.1
Administrative procedure NOS	1,774	1.7	1.5	1.8	246	1.3	1.0	1.6
Weakness/tiredness	1,770	1.7	1.5	1.8	296	1.6	1.2	1.9
Upper respiratory tract infection	1,742	1.6	1.5	1.8	283	1.5	1.2	1.8
Hypertension/high blood pressure*	1,699	1.6	1.4	1.8	465	2.5	1.9	3.1
Ear Pain	1,661	1.6	1.5	1.6	273	1.5	1.2	1.7
Fever	1,653	1.6	1.4	1.7	325	1.7	1.2	2.2
Skin complaint	1,624	1.5	1.4	1.6	324	1.7	1.1	2.3
Headache	1,584	1.5	1.4	1.6	363	1.9	1.6	2.3
<b>Total RFEs</b>	<b>161,059</b>	<b>150.7</b>	<b>149.2</b>	<b>152.1</b>	<b>28,224</b>	<b>150.1</b>	<b>146.0</b>	<b>154.3</b>

Note: Shading indicates statistically significant differences between groups. UCL—upper confidence limit; LCL— lower confidence limit. \* Includes multiple ICPC-2 or ICPC-2 PLUS codes

#### 4.2.6 Problems managed at the encounter by GP clinical computer use status

The diagnosis or problem managed at the encounter is the formal label or statement of the health issue presented to the GP by the patient. Sometimes a clear diagnosis can be reached, but often one cannot be determined without follow-up or further investigation. GPs were instructed to record each problem at the most specific level (i.e. the highest diagnostic level) possible from the information available accepting that at times this will be limited to the signs and symptoms presented.(43)

For each patient, the GP could record up to four problems being managed at the encounter, with a minimum of one being compulsory. The status of each problem (new or old) to the patient was also specified. Unlike the hospital system, the concept of a ‘principal diagnosis’ is not relevant in general practice as the patient may present with problems from different body systems, some of which may be symptoms of a common problem, but others may also

not be related in any way. Some may be of a chronic nature and others acute, some may be physical, while others may be social or psychological, but all requiring management at the same encounter. As none of these problems may necessarily be of more significance than others, the order in which the problems are recorded by the GP is not important.(44)

### Number of problems managed at the encounter by GP clinical computer use status

In Section 4.2.3 (Table 4.5) the average number of problems managed per 100 encounters was shown to be significantly higher for clinical computer users than for non clinical computer users (150.5 per 100 encounters, 95% CI: 148.8-152.2 cf. 144.1, 95% CI: 140.1-148.1). The relative distribution of problems across encounters is compared in Table 4.11. There are significant differences in the rate of problems managed at each level. Compared with GPs not using a computer for clinical activity, clinical computer users were significantly less likely to manage a single problem at the encounter (63.6 per 100 encounters, 95% CI: 63.3-63.9 cf. 67.3, 95% CI: 66.6-68.0), but far more likely to manage two (24.9 per 100 encounters, 95% CI: 24.7-25.2 cf. 23.3, 95% CI: 22.7-23.9), three (8.7 per 100 encounters, 95% CI: 8.5-8.9 cf. 7.3, 95% CI: 7.0-7.7), or four (2.7 per 100 encounters, 95% CI: 2.6-2.8 cf. 2.0, 95% CI: 1.8-2.2) problems per encounter.

**Table 4.11: Number of problems managed at the encounter**

Number of problems managed	GPs using a computer for clinical purposes				GPs not using a computer for clinical purposes			
	Number	Per cent of encounters (n=106,900)	95% LCL	95% UCL	Number	Per cent encounters (n=18,800)	95% LCL	95% UCL
One	68,029	63.6	63.3	63.9	12,653	67.3	66.6	68.0
Two	26,644	24.9	24.7	25.2	4,385	23.3	22.7	23.9
Three	9,320	8.7	8.5	8.9	1,380	7.3	7.0	7.7
Four	2,907	2.7	2.6	2.8	382	2.0	1.8	2.2
<b>Total</b>	<b>106,900</b>	<b>100.0</b>	—	—	<b>18,800</b>	<b>100.0</b>	—	—

Note: Shading indicates statistically significant differences between groups. UCL—upper confidence limit; LCL— lower confidence limit.

### Distribution of problems managed by ICPC-2 Chapter by GP clinical computer use status

As with the patient reasons for encounter, the problems managed were also classified according to the ICPC-2. The distribution of the problems managed at the encounter is shown in Table 4.12, and some significant differences were noted. Apart from the significantly higher rate of problems managed, compared to non clinical computer users, encounters with clinical computer users involved significantly more problems that were:

- of a general or unspecified nature (16.5 per 100 encounters, 95% CI: 15.9-17.0 cf. 12.9, 95% CI: 11.2-14.5)
- related to the female genital system (7.2 per 100 encounters, 95% CI: 6.7-7.6 cf. 5.3, 95% CI: 4.1-6.5)
- related to pregnancy or family planning (4.5 per 100 encounters, 95% CI: 4.2-4.7 cf. 3.2, 95% CI: 2.4-4.0).

There were no significant differences in the relative rates of management of problems associated with the respiratory system; the skin; the musculoskeletal system; the circulatory system; the endocrine & metabolic system; the digestive system; the ear; the neurological system, the blood or blood forming organs; the male genital system; social problems; or those of a psychological nature.

**Table 4.12: Problems managed by ICPC-2 chapters**

Problems managed	GPs using a computer for clinical purposes				GPs not using a computer for clinical purposes			
	Number	Rate per 100 encounters (n=106,900)	95% LCL	95% UCL	Number	Rate per 100 encounters (n=18,800)	95% LCL	95% UCL
Respiratory	19,740	18.5	17.9	19.0	3,276	17.4	16.0	18.8
Skin	19,050	17.8	17.2	18.5	3,484	18.5	15.4	21.7
Musculoskeletal	18,578	17.4	16.9	17.8	3,234	17.2	15.8	18.6
General & unspecified	17,621	16.5	15.9	17.0	2,418	12.9	11.2	14.5
Circulatory	17,574	16.4	15.8	17.0	3,368	17.9	16.2	19.6
Psychological	12,953	12.1	11.5	12.7	2,325	12.4	10.8	13.9
Endocrine & metabolic	12,855	12.0	11.6	12.5	2,315	12.3	11.0	13.6
Digestive	10,705	10.0	9.8	10.3	1,896	10.1	9.4	10.8
Female genital system	7,665	7.2	6.7	7.6	997	5.3	4.1	6.5
Pregnancy & family planning	4,796	4.5	4.2	4.7	603	3.2	2.4	4.0
Ear	4,391	4.1	4.0	4.3	729	3.9	2.8	4.9
Neurological	4,035	3.8	3.6	3.9	700	3.7	3.3	4.2
Urology	3,396	3.2	3.0	3.3	508	2.7	2.4	3.0
Eye	2,872	2.7	2.6	2.8	494	2.6	2.3	2.9
Blood	1,908	1.8	1.6	2.0	290	1.5	1.3	1.8
Male genital system	1,779	1.7	1.6	1.8	335	1.8	1.3	2.3
Social	987	0.9	0.8	1.0	119	0.6	0.5	0.8
<b>Total problems</b>	<b>160,905</b>	<b>150.5</b>	<b>148.8</b>	<b>152.2</b>	<b>27,091</b>	<b>144.1</b>	<b>140.1</b>	<b>148.1</b>

Note: Shading indicates statistically significant differences between groups. UCL—upper confidence limit; LCL— lower confidence limit

### The most frequent individual problems managed by GP clinical computer use status

The management rates of the most common individual problems managed at encounters with both GP groups are shown in Table 4.13. At encounters with clinical computer users, hypertension was managed significantly less often (8.7 per 100 encounters, 95% CI: 8.3-9.1 cf. 11.0, 95% CI: 9.7-12.2). Problems managed significantly more often at encounters with clinical computer users included “prescription” (unspecified problem) (2.4 per 100 encounters, 95% CI: 2.2-2.7 cf. 1.6, 95% CI: 1.2-2.1), female genital check-ups (2.4 per 100 encounters, 95% CI: 2.2-2.6 cf. 1.6, 95% CI: 1.0-2.1), and general health check-ups (2.4 per 100 encounters, 95% CI: 2.2-2.5 cf. 1.5, 95% CI: 1.1-1.9).

**Table 4.13: Most frequent individual problems managed at the encounter**

Problems managed	GPs using a computer for clinical purposes				GPs not using a computer for clinical purposes			
	Number	Rate per 100 encounters (n=106,900)	95% LCL	95% UCL	Number	Rate per 100 encounters (n=18,800)	95% LCL	95% UCL
Hypertension*	9,339	8.7	8.3	9.1	2,061	11.0	9.7	12.2
Preventive immun/vacc/meds-all*	5,759	5.4	4.9	5.8	753	4.0	2.7	5.3
Upper respiratory infection, acute	5,076	4.8	4.5	5.0	914	4.9	4.2	5.5
Depression*	4,344	4.1	3.8	4.3	716	3.8	3.3	4.3
Lipid disorders*	3,576	3.4	3.2	3.5	665	3.5	3.0	4.1
Diabetes*	3,438	3.2	3.0	3.4	688	3.7	3.1	4.2
Back complaint*	2,970	2.8	2.6	2.9	507	2.7	2.3	3.1
Osteoarthritis*	2,887	2.7	2.5	2.9	475	2.5	2.1	2.9
Prescription all*	2,577	2.4	2.2	2.7	308	1.6	1.2	2.1
Female genital check-up*	2,563	2.4	2.2	2.6	295	1.6	1.0	2.1
Asthma	2,543	2.4	2.3	2.5	376	2.0	1.7	2.3
General check-up*	2,517	2.4	2.2	2.5	286	1.5	1.1	1.9
Oesophagus disease	2,272	2.1	2.0	2.2	377	2.0	1.7	2.4
Acute bronchitis/ bronchiolitis	2,252	2.1	2.0	2.3	393	2.1	1.7	2.5
Anxiety*	1,891	1.8	1.6	1.9	380	2.0	1.6	2.4
Dermatitis, contact/allergic	1,888	1.8	1.7	1.9	317	1.7	1.5	1.9
UTI*	1,868	1.8	1.7	1.8	275	1.5	1.2	1.7
Sleep disturbance	1,860	1.7	1.6	1.9	297	1.6	1.3	1.9
Sprain/Strain*	1,569	1.5	1.4	1.6	314	1.7	1.3	2.0
Oral contraception*	1,551	1.5	1.3	1.6	199	1.1	0.8	1.3
Test results*	1,530	1.4	1.3	1.5	219	1.2	0.9	1.4
Solar keratosis/sunburn	1,487	1.4	1.2	1.6	440	2.3	1.1	3.6
Ischaemic Heart Disease*	1,340	1.3	1.2	1.4	196	1.0	0.8	1.3
Malignant neoplasm skin	1,285	1.2	1.0	1.4	370	2.0	1.0	3.0
<b>Total problems</b>	<b>160,905</b>	<b>150.5</b>	<b>148.8</b>	<b>152.2</b>	<b>27,091</b>	<b>144.1</b>	<b>140.1</b>	<b>148.1</b>

Note: Shading indicates statistically significant differences between groups. UCL–upper confidence limit; LCL– lower confidence limit. \* Includes multiple ICPC-2 or ICPC-2 PLUS codes

#### 4.2.7 Management of problems by GP clinical computer use status

The overall prescribing rates (including prescribing rates, rates of non pharmacological treatments etc.) were compared earlier (Table 4.6) and showed that, compared with non clinical computer users, clinical computer users prescribed medications at a significantly lower rate and ordered pathology tests at a significantly higher rate per 100 encounters.

These results were reflected in analysis of the number of encounters at which at least one form of management was recorded by the GPs (Table 4.14). While there was no difference in

the likelihood of providing a treatment, referral or investigation of any type, compared with non clinical computer users, clinical computer users:

- were significantly less likely to prescribe at least one medication (53.1%, 95% CI: 52.2-53.9 cf. 57.1, 95% CI: 54.3-59.8)
- were significantly more likely to order at least one investigation of any type (23.6%, 95% CI: 23.1-24.2 cf. 20.4%, 95% CI: 18.7-22.1), and in particular,
- were significantly more likely to order at least one pathology test (17.6%, 95% CI: 17.1-18.1 cf. 14.9%, 95% CI: 13.3-16.4).

**Table 4.14: Encounters at which management was recorded**

Management type	GPs using a computer for clinical purposes				GPs not using a computer for clinical purposes			
	Number	Percent of encounters (n=106,900)	95% LCL	95% UCL	Number	Percent of encounters (n=18,800)	95% LCL	95% UCL
<b>At least one treatment, referral or investigation</b>	97,735	91.4	91.0	91.9	17,365	92.4	91.0	93.7
<b>At least one treatment type</b>	87,280	81.6	81.0	82.3	15,773	83.9	82.1	85.7
<b>At least one medication</b>	67,395	63.0	62.3	63.8	12,455	66.3	63.7	68.8
At least one prescription	56,716	53.1	52.2	53.9	10,726	57.1	54.3	59.8
At least one OTC advised	8,934	8.4	7.9	8.8	1,607	8.5	7.3	9.8
At least one GP supplied	7,635	7.1	6.6	7.7	1,192	6.3	4.9	7.8
<b>At least one non-pharmacological treatment</b>	46,738	43.7	42.5	45.0	8,167	43.4	39.8	47.0
At least one clinical treatment	33,048	30.9	29.7	32.1	5,816	30.9	27.8	34.1
At least one therapeutic procedure	17,737	16.6	16.0	17.2	3,169	16.9	14.5	19.2
<b>At least one referral</b>	12,585	11.8	11.4	12.1	2,088	11.1	10.1	12.1
At least one referral to specialist	8,569	8.0	7.7	8.3	1,363	7.3	6.5	8.0
At least one referral to allied health service	3,066	2.9	2.7	3.0	490	2.6	2.1	3.1
At least one referral to hospital	597	0.6	0.5	0.7	137	0.7	0.5	1.0
At least one referral to emergency dept	161	0.2	0.1	0.2	38	0.2	0.1	0.3
At least one referral NOS	532	0.5	0.4	0.6	110	0.6	0.3	0.9
<b>At least one investigation</b>	25,252	23.6	23.1	24.2	3,838	20.4	18.7	22.1
At least one pathology order	18,819	17.6	17.1	18.1	2,795	14.9	13.3	16.4
At least one imaging order	8,052	7.5	7.3	7.8	1,312	7.0	6.2	7.7
At least one other investigation	1,143	1.1	1.0	1.1	164	0.9	0.7	1.1

### **Medication management by GP clinical computer use status**

As previously shown in Section 4.2.3 (Table 4.5), the overall medication rate per 100 encounters, the rate of GP supplied medications and the rate of over-the-counter medications did not differ significantly between clinical computer users and non-clinical computer users. However, the prescribed medication rates were significantly higher for clinical computer users (81.9 per 100 encounters, 95% CI: 80.1-83.7 cf. 89.8, 95% CI: 83.9-95.7).

#### ***Prescribed medications***

The distribution of medications commonly prescribed by group, sub-group and generic name are shown in Table 4.15, in order of medication group and subgroup frequency. Compared to non clinical computer users, clinical computer users prescribed significantly lower rates of:

- medications acting on the cardiovascular system, particularly anti-hypertensives
- medications acting on the central nervous system, particularly simple analgesics (specifically paracetamol)
- hypoglycaemic agents
- medications acting on the musculoskeletal system, particularly non-steroidal anti-inflammatory drugs,

and significantly higher rates of:

- contraceptives, particularly levonorgestrel / ethinyloestradiol.

There were no other significant differences in the rates of other prescribed medication groups, subgroups or generic medications between the two GP groups.

**Table 4.15: Common medications prescribed, by group, subgroup and generic medication**

Sub Group	group	Generic	GPs using a computer for clinical purposes			GPs not using a computer for clinical purposes				
			No.	Rate per 100 encounters (n=106,900)	95% LCL	95% UCL	No.	Rate per 100 encounters (n=18,800)	95% LCL	95% UCL
Cardiovascular			14,749	13.8	13.2	14.4	3,140	16.7	14.5	18.9
	Antihypertensives		8,147	7.6	7.3	8.0	1,803	9.6	8.3	10.9
		Irbesartan	905	0.9	0.8	0.9	192	1.0	0.8	1.2
		Perindopril	839	0.8	0.7	0.9	177	0.9	0.7	1.2
		Ramipril	818	0.8	0.7	0.8	185	1.0	0.8	1.2
		Irbesartan/Hydro-chlorothiazide	684	0.6	0.6	0.7	156	0.8	0.6	1.1
		Amlodipine	639	0.6	0.5	0.7	151	0.8	0.6	1.0
	Other CVS drugs		3,284	3.1	2.9	3.2	633	3.4	2.9	3.9
		Atorvastatin	1,444	1.4	1.3	1.4	290	1.5	1.2	1.8
		Simvastatin	1,180	1.1	1.0	1.2	214	1.1	0.9	1.4
	Beta-blockers		1,675	1.6	1.5	1.7	379	2.0	1.7	2.4
		Atenolol	966	0.9	0.8	1.0	209	1.1	0.9	1.3
	Anti-angina		787	0.7	0.7	0.8	169	0.9	0.7	1.1
Anti-infections/infestations			14,526	13.6	13.1	14.0	2,589	13.8	12.6	14.9
	Broadspectrumpenicillins		4,860	4.6	4.3	4.8	946	5.0	4.4	5.6
		Amoxicillin	3,192	3.0	2.8	3.2	629	3.4	2.8	3.9
		Amoxicillin/potass.clavulanate	1,654	1.6	1.4	1.7	316	1.7	1.4	2.0
	Penicillin/Cephalosporins		4,402	4.1	3.9	4.3	731	3.9	3.4	4.4
		Cephalexin	2,378	2.2	2.1	2.4	352	1.9	1.6	2.2
		Cefaclor monohydrate	660	0.6	0.5	0.7	150	0.8	0.6	1.0
	Other antibiotics		2,829	2.7	2.5	2.8	468	2.5	2.1	2.9
		Roxithromycin	1,077	1.0	0.9	1.1	211	1.1	0.9	1.4
	Anti-infectives		981	0.9	0.8	1.1	138	0.7	0.6	0.9
	Tetracyclines		909	0.9	0.8	0.9	200	1.1	0.8	1.3
		Doxycycline	741	0.7	0.6	0.8	155	0.8	0.6	1.0
CNS			10,318	9.7	9.2	10.1	2,260	12.0	10.6	13.4
	Simple analgesics		3,179	3.0	2.8	3.2	796	4.2	3.5	4.9
		Paracetamol	2,463	2.3	2.1	2.5	639	3.4	2.8	4.0
		Aspirin	703	0.7	0.6	0.7	156	0.8	0.6	1.0
	Narcotic analgesics		2,701	2.5	2.3	2.8	519	2.8	2.1	3.4
		Tramadol	1,018	1.0	0.9	1.0	174	0.9	0.7	1.1

(Continued)

**Table 4.15 (continued): Common medications prescribed, by group, subgroup and generic medication**

Group	Sub group	Generic	GPs using a computer for clinical purposes			GPs not using a computer for clinical purposes				
			No.	Rate per 100 encounters (n=106,900)	95% LCL	95% UCL	No.	Rate per 100 encounters (n=18,800)	95% LCL	95% UCL
		Compound analgesic	2,405	2.3	2.1	2.4	502	2.7	2.2	3.1
		Paracetamol/ Codeine	2,017	1.9	1.8	2.0	425	2.3	1.8	2.7
		Antiemetic/Antinauseant	1,248	1.2	1.1	1.3	265	1.4	1.2	1.7
Psychological			8,252	7.7	7.4	8.1	1,609	8.6	7.4	9.7
		Antidepressants	3,535	3.3	3.1	3.5	590	3.1	2.7	3.6
		Antianxiety	2,080	2.0	1.8	2.1	512	2.7	2.1	3.4
		Diazepam	1,134	1.1	1.0	1.2	287	1.5	1.2	1.9
		Oxazepam	684	0.6	0.6	0.7	173	0.9	0.6	1.2
		Sedatives/Hypnotics	2,053	1.9	1.8	2.0	340	1.8	1.5	2.1
		Temazepam	1,308	1.2	1.1	1.3	231	1.2	1.0	1.4
		Antipsychotic	584	0.6	0.5	0.6	167	0.9	0.5	1.3
Hormones			5,643	5.3	5.0	5.5	1,131	6.0	5.2	6.9
		Hypoglycaemic	2,022	1.9	1.7	2.0	511	2.7	2.1	3.3
		Metformin	943	0.9	0.8	1.0	211	1.1	0.8	1.4
		Sex hormones/Anabolic	1,550	1.5	1.3	1.6	238	1.3	1.0	1.5
		Corticosteroids	1,245	1.2	1.1	1.3	228	1.2	1.0	1.4
Musculoskeletal			5,218	4.9	4.7	5.1	1,157	6.2	5.5	6.8
		NSAID	4,400	4.1	3.9	4.3	937	5.0	4.4	5.6
		Celecoxib	1,021	1.0	0.9	1.0	193	1.0	0.8	1.2
		Diclofenac sodium systemic	842	0.8	0.7	0.9	195	1.0	0.8	1.2
Respiratory			4,436	4.2	3.9	4.4	762	4.1	3.5	4.6
		Bronchodilator/Spasm relaxant	2,130	2.0	1.9	2.1	376	2.0	1.7	2.3
		Salbutamol	1,475	1.4	1.3	1.5	271	1.4	1.2	1.7
		Asthma preventives	1,844	1.7	1.6	1.8	295	1.6	1.4	1.8
		Fluticasone/ Salmeterol	876	0.8	0.8	0.9	144	0.8	0.6	0.9
Skin			4,161	3.9	3.7	4.1	711	3.8	3.4	4.2
		Topical steroids	2,755	2.6	2.5	2.7	446	2.4	2.1	2.7
		Mometasone	755	0.7	0.6	0.8	107	0.6	0.4	0.7
		Betamethasone topical	747	0.7	0.6	0.8	121	0.6	0.5	0.8

(continued)

**Table 4.15 (continued): Common medications prescribed, by group, subgroup and generic medication**

Sub Group	Sub group	Generic	GPs using a computer for clinical purposes			GPs not using a computer for clinical purposes				
			No.	Rate per 100 encounters (n=106,900)	95% LCL	95% UCL	No.	Rate per 100 encounters (n=18,800)	95% LCL	95% UCL
Digestive			4,073	3.8	3.6	4.0	819	4.4	3.9	4.9
	Antiuclerants		2,775	2.6	2.5	2.7	526	2.8	2.4	3.2
		Esomeprazole	734	0.7	0.6	0.8	126	0.7	0.5	0.8
		Omeprazole	715	0.7	0.6	0.7	143	0.8	0.6	1.0
Allergy, immune system			4,004	3.8	3.4	4.1	568	3.0	2.4	3.6
	Immunization		3,577	3.4	3.0	3.6	459	2.4	1.8	3.1
		Influenza virus vaccine	1,229	1.2	1.0	1.3	183	1.0	0.5	1.4
Blood			2,249	2.1	2.0	2.2	420	2.2	1.8	2.7
	Other blood drugs		1,387	1.3	1.2	1.4	253	1.4	1.0	1.7
		Warfarin sodium	1,034	1.0	0.9	1.1	189	1.0	0.7	1.3
	Haemopoietics		861	0.8	0.7	0.9	166	0.9	0.7	1.1
Contraceptives			2,047	1.9	1.8	2.0	242	1.3	1.0	1.5
	Contraceptives oral/systemic		2,026	1.9	1.8	2.0	242	1.3	1.0	1.5
		Levonorgestrel/Ethinylloestradiol	1,326	1.2	1.2	1.3	168	0.9	0.7	1.1
Urogenital			1,868	1.8	1.6	1.9	357	1.9	1.6	2.2
	Diuretic		1,054	1.0	0.9	1.1	223	1.2	0.9	1.4
Ear, nose topical			1,718	1.6	1.5	1.7	284	1.5	1.2	1.8
	Topical otic		986	0.9	0.8	1.0	174	0.9	0.7	1.1
Eye medications			1,677	1.6	1.5	1.7	321	1.7	1.5	1.9
	Anti-infectives eye		1,045	1.0	0.9	1.0	200	1.1	0.9	1.2
		Chloramphenicol eye	925	0.9	0.8	0.9	178	1.0	0.8	1.1
Nutrition, metabolism			1,656	1.6	1.4	1.7	323	1.7	1.4	2.0
Anti neoplastics			423	0.4	0.3	0.4	86	0.5	0.1	0.8
Miscellaneous			314	0.3	0.3	0.3	69	0.4	0.3	0.5
Surgical preparations			129	0.1	0.1	0.2	24	0.1	0.1	0.2
Diagnostic agents			68	0.1	0.0	0.1	17	0.1	0.0	0.1
<b>Total Meds</b>			<b>87,529</b>	<b>81.9</b>	<b>80.1</b>	<b>83.7</b>	<b>16,889</b>	<b>89.8</b>	<b>83.9</b>	<b>95.7</b>

Note: Shading indicates statistically significant differences between groups. UCL—upper confidence limit; LCL— lower confidence limit.

### Non-pharmacological management by GP clinical computer use status

Earlier in this report (Section 4.2.3, Table 4.5) it was shown that clinical computer users and non clinical computer users did not differ in their rates of providing non-pharmacological clinical treatments (such as counselling). Table 4.16 shows the top ten clinical treatments provided by both GP groups (which accounted for approximately 86% of clinical treatments for each). GPs using a computer for clinical purposes provided counselling/advice for nutrition or weight problems significantly less often than their counterparts. While the confidence intervals for psychological counselling and other administration/documentation showed a marginal difference, there were no significant differences between the two GP groups in the rate per 100 encounters for any other non pharmacological treatments listed.

**Table 4.16: Clinical treatments**

Clinical treatment	GPs using a computer for clinical purposes				GPs not using a computer for clinical purposes			
	Number	Rate per 100 encounters (n=106,900)	95% LCL	95% UCL	Number	Rate per 100 encounters (n=18,800)	95% LCL	95% UCL
Advice / education*	7,811	7.31	6.7	7.9	1,416	7.53	5.9	9.2
Counselling - problem*	5,114	4.78	4.3	5.3	948	5.04	3.2	6.9
Counsel / advice – nutrition / weight*	4,904	4.59	4.2	4.9	1,224	6.51	5.2	7.8
Advice / education – treatment*	4,338	4.06	3.7	4.4	831	4.42	3.6	5.2
Advice / education – medication*	3,848	3.60	3.3	3.9	565	3.01	2.4	3.6
Counselling – psychological*	3,690	3.45	3.2	3.7	516	2.74	2.2	3.3
Counsel / advice – exercise*	1,812	1.70	1.5	1.9	364	1.94	1.3	2.6
Other admin / documentation*	1,811	1.69	1.5	1.8	219	1.16	0.9	1.5
Reassurance, support	1,741	1.63	1.5	1.8	295	1.57	1.1	2.1
Sickness certificate	1,587	1.48	1.3	1.6	207	1.10	0.6	1.6
<b>Subtotal (% of total)</b>	<b>36,656</b>	<b>83.3</b>	<b>–</b>	<b>–</b>	<b>6,585</b>	<b>87.3</b>	<b>–</b>	<b>–</b>
<b>Total clinical treatments</b>	<b>42,485</b>	<b>39.74</b>	<b>37.9</b>	<b>41.5</b>	<b>7,547</b>	<b>40.14</b>	<b>35.4</b>	<b>44.9</b>

\* Includes multiple ICPC-2 or ICPC-2 PLUS codes

### Procedural treatments by GP clinical computer use status

Only one significant difference was found between the two GP groups in the types of procedural treatments provided per 100 encounters – clinical computer users provided preventive procedures significantly more often than non clinical computer users. The procedural treatments shown in Table 4.17 accounted for over 90% of those provided by each group.

**Table 4.17: Procedural treatments**

Procedural treatment	GPs using a computer for clinical purposes				GPs not using a computer for clinical purposes			
	Number	Rate per 100 encounters (n=106,900)	95% LCL	95% UCL	Number	Rate per 100 encounters (n=18,800)	95% LCL	95% UCL
Local injection / infiltration*	3,914	3.7	3.4	4.0	669	3.6	2.4	4.7
Excision / removal tissue / biopsy / destruction / debridement / cauterisation*	3,592	3.4	3.0	3.7	844	4.5	2.5	6.4
Dressing / pressure / compression / tamponade*	2,117	2.0	1.8	2.1	318	1.7	1.3	2.0
Physical medicine / rehabilitation*	1,862	1.7	1.6	1.9	398	2.1	1.6	2.7
Pap smear*	1,452	1.4	1.2	1.5	181	1.0	0.4	1.5
Other therapeutic procedures / surgery NEC*	1,229	1.2	1.0	1.3	332	1.8	0.6	2.9
Incision / drainage / flushing / aspiration / removal body fluid*	1,175	1.1	1.0	1.2	204	1.1	0.9	1.3
Repair / fixation – suture / cast / prosthetic device (apply / remove)*	966	0.9	0.8	1.0	177	0.9	0.7	1.2
Other preventive procedures*	497	0.5	0.4	0.6	33	0.2	0.1	0.3
Physical function test*	457	0.4	0.4	0.5	96	0.5	0.0	1.0
Glucose test	237	0.2	0.2	0.3	50	0.3	0.2	0.4
<b>Subtotal (% of total)</b>	<b>17,261</b>	<b>91.6</b>	<b>–</b>	<b>–</b>	<b>3,269</b>	<b>94.3</b>	<b>–</b>	<b>–</b>
<b>Total procedural treatments</b>	<b>18,831</b>	<b>17.6</b>	<b>16.9</b>	<b>18.3</b>	<b>3,465</b>	<b>18.4</b>	<b>15.7</b>	<b>21.2</b>

\* Includes multiple ICPC-2 or ICPC-2 PLUS codes; LCL–lower confidence limit; UCL–upper confidence limit; shading–statistically significant differences between groups.

### Referrals by GP clinical computer use status

As shown earlier in Section 4.2.3 (Table 4.5), there were no significant differences between the two GP groups in the total referral rates or in rates of referrals to medical specialists or to allied health professionals. Table 4.18 shows the most common specific referrals per 100 encounters to medical specialists, and Table 4.19 the rates of referrals to more specific types of allied health professional. There remained no significant differences between clinical computer users and non clinical computer users at this more specific level.

**Table 4.18: Referrals to medical specialists**

Medical specialists	GPs using a computer for clinical purposes				GPs not using a computer for clinical purposes			
	Number	Rate per 100 encounters (n=106,900)	95% LCL	95% UCL	Number	Rate per 100 encounters (n=18,800)	95% LCL	95% UCL
Referral; surgeon	919	0.9	0.8	0.9	155	0.8	0.6	1.0
Referral; ophthalmologist	899	0.8	0.8	0.9	135	0.7	0.6	0.9
Referral; dermatologist	816	0.8	0.7	0.8	135	0.7	0.6	0.9
Referral; orthopaedic surgeon	797	0.8	0.7	0.8	133	0.7	0.5	0.9
Referral; gynaecologist	639	0.6	0.5	0.7	95	0.5	0.4	0.6
Referral; ENT	589	0.6	0.5	0.6	93	0.5	0.4	0.6
Referral; cardiologist	541	0.5	0.5	0.6	91	0.5	0.3	0.7
Referral; gastroenterologist	444	0.4	0.4	0.5	75	0.4	0.3	0.5
Referral; urologist	313	0.3	0.3	0.3	42	0.2	0.2	0.3
Referral; psychiatrist	287	0.3	0.2	0.3	53	0.3	0.2	0.4
Referral; neurologist	262	0.3	0.2	0.3	43	0.2	0.1	0.3
<b>Subtotal (%of total)</b>	<b>6,244</b>	<b>70.3</b>	<b>–</b>	<b>–</b>	<b>1,008</b>	<b>69.0</b>	<b>–</b>	<b>–</b>
<b>Total referrals to medical specialists</b>	<b>8,886</b>	<b>8.3</b>	<b>8.0</b>	<b>8.6</b>	<b>1,460</b>	<b>7.5</b>	<b>6.7</b>	<b>8.3</b>

**Table 4.19: Referrals to allied health professionals**

Allied health professionals	GPs using a computer for clinical purposes				GPs not using a computer for clinical purposes			
	Number	Rate per 100 encounters (n=106,900)	95% LCL	95% UCL	Number	Rate per 100 encounters (n=18,800)	95% LCL	95% UCL
Referral; physiotherapist	1,146	1.1	1.0	1.2	194	1.0	0.7	1.3
Referral; psychologist	281	0.3	0.2	0.3	31	0.2	0.1	0.2
Referral; podiatrist/ chiropodist	265	0.3	0.2	0.3	36	0.2	0.1	0.3
Referral; dietitian/ nutritionist	226	0.2	0.2	0.2	27	0.1	0.1	0.2
Referral; dentist	183	0.2	0.1	0.2	37	0.2	0.1	0.3
Referral; acoustic testing	115	0.1	0.1	0.1	15	0.1	0.0	0.1
Referral; diabetes education	89	0.1	0.1	0.1	12	0.1	0.0	0.1
Referral; counsellor	88	0.1	0.1	0.1	19	0.1	0.0	0.2
Referral; mental health team	74	0.1	0.1	0.1	17	0.1	0.0	0.1
Referral; optometrist	62	0.1	0.0	0.1	8	0.0	0.0	0.1
Referral; drug & alcohol	58	0.1	0.0	0.1	15	0.1	0.0	0.1
Referral; rehabilitation	30	0.0	0.0	0.0	13	0.1	0.0	0.1
<b>Subtotal</b>	<b>2,529</b>	<b>79.4</b>	<b>-</b>	<b>-</b>	<b>404</b>	<b>79.7</b>	<b>-</b>	<b>-</b>
<b>Total referrals to allied health</b>	<b>3,184</b>	<b>3.0</b>	<b>2.8</b>	<b>3.1</b>	<b>507</b>	<b>2.7</b>	<b>2.2</b>	<b>3.2</b>

### **Pathology tests and imaging orders by GP clinical computer use status**

Table 4.5 (Section 4.2.3) showed that clinical computer users recorded a significantly higher rate of pathology orders per 100 encounters than did their counterparts (41.6 per 100 encounters, 95% CI: 40.2-43.0 cf. 32.6 per 100, 95% CI: 28.7-36.5). The more common specific pathology test types are shown in Table 4.20. Compared to non clinical computer users, clinical compute users ordered significantly more:

- Chemistry tests generally (22.6 per 100 encounters, 95% CI: 21.7-23.4 cf. 17.7 per 100, 95% CI: 15.2-20.2), in particular –
  - tests for lipids (3.9 per 100 encounters, 95% CI: 3.7-4.1 cf. 3.1 per 100, 95% CI: 2.6-3.6)
  - liver function tests (2.7 per 100 encounters, 95% CI: 2.6-2.9 cf. 2.0 per 100, 95% CI: 1.6-2.4)
  - thyroid function tests (2.4 per 100 encounters, 95% CI: 2.3-2.6 cf. 1.9 per 100, 95% CI: 1.5-2.2)
- tests classified as haematology (7.8 per 100 encounters, 95% CI: 7.5-8.2 cf. 6.4 per 100, 95% CI: 5.3-7.4)
- tests classified as microbiology (6.4 per 100 encounters, 95% CI: 6.0-6.8 cf. 3.9 per 100, 95% CI: 3.1-4.6), in particular –
  - urine MC&S tests (1.9 per 100 encounters, 95% CI: 1.8-2.0 cf. 1.4 per 100, 95% CI: 1.2-1.7)
  - other microbiology tests (0.9 per 100 encounters, 95% CI: 0.8-1.0 cf. 0.3 per 100, 95% CI: 0.2-0.4)

There were no significant differences between the two groups in the ordering rates of any other types of pathology tests.

There were no significant differences between clinical computer users non clinical computer users in the rates of orders for imaging overall (Section 4.3.3, Table 4.5) or in the more specific imaging tests shown in Table 4.21.

**Table 4.20: Pathology orders by MBS pathology groups**

Pathology test ordered	GPs using a computer for clinical purposes				GPs not using a computer for clinical purposes			
	Number	Rate per 100 encs (n=106,900)	95% LCL	95% UCL	Number	Rate per 100 encs (n=18,800)	95% LCL	95% UCL
<b>Chemistry</b>	<b>24,103</b>	<b>22.6</b>	<b>21.7</b>	<b>23.4</b>	<b>3,327</b>	<b>17.7</b>	<b>15.2</b>	<b>20.2</b>
Lipids	4,133	3.9	3.7	4.1	588	3.1	2.6	3.6
Electrolyte, Urea & Creatinine	3,164	3.0	2.7	3.2	423	2.3	1.7	2.8
Liver function	2,928	2.7	2.6	2.9	370	2.0	1.6	2.4
Thyroid function	2,597	2.4	2.3	2.6	351	1.9	1.5	2.2
Glucose/tolerance	2,551	2.4	2.2	2.5	398	2.1	1.7	2.5
Multibiochemical analysis	1,764	1.7	1.4	1.9	239	1.3	0.6	1.9
Ferritin	1,096	1.0	0.9	1.1	126	0.7	0.4	0.9
Chemistry; other	1,088	1.0	0.9	1.1	176	0.9	0.7	1.2
HbA1c	1,044	1.0	0.9	1.1	153	0.8	0.6	1.0
Hormone assay	918	0.9	0.8	1.0	127	0.7	0.4	0.9
Prostate specific antigen	629	0.6	0.5	0.6	101	0.5	0.4	0.7
C reactive protein	534	0.5	0.4	0.6	50	0.3	0.2	0.4
<b>Haematology</b>	<b>8,356</b>	<b>7.8</b>	<b>7.5</b>	<b>8.2</b>	<b>1,192</b>	<b>6.3</b>	<b>5.3</b>	<b>7.4</b>
Full blood count	5,819	5.4	5.2	5.7	823	4.4	3.5	5.2
Erythrocyte Sedimentation Rate	1,170	1.1	1.0	1.2	157	0.8	0.6	1.1
Coagulation	955	0.9	0.8	1.0	163	0.9	0.7	1.1
<b>Microbiology</b>	<b>6,837</b>	<b>6.4</b>	<b>6.0</b>	<b>6.8</b>	<b>725</b>	<b>3.9</b>	<b>3.1</b>	<b>4.6</b>
Urine MC&S	2,045	1.9	1.8	2.0	267	1.4	1.2	1.7
Microbiology; other	938	0.9	0.8	1.0	63	0.3	0.2	0.4
Hepatitis serology	670	0.6	0.6	0.7	77	0.4	0.2	0.6
<b>Cytopathology</b>	<b>2,533</b>	<b>2.4</b>	<b>2.1</b>	<b>2.6</b>	<b>287</b>	<b>1.5</b>	<b>0.9</b>	<b>2.1</b>
Pap smear	2,502	2.3	2.1	2.6	283	1.5	0.9	2.1
<b>Other NEC</b>	<b>812</b>	<b>0.8</b>	<b>0.7</b>	<b>0.9</b>	<b>187</b>	<b>1.0</b>	<b>0.7</b>	<b>1.3</b>
Blood test	270	0.3	0.2	0.3	75	0.4	0.2	0.6
<b>Histopathology</b>	<b>779</b>	<b>0.7</b>	<b>0.6</b>	<b>0.8</b>	<b>269</b>	<b>1.4</b>	<b>0.6</b>	<b>2.3</b>
Histology; skin	723	0.7	0.6	0.8	239	1.3	0.6	1.9
<b>Immunology</b>	<b>609</b>	<b>0.6</b>	<b>0.5</b>	<b>0.6</b>	<b>69</b>	<b>0.4</b>	<b>0.2</b>	<b>0.5</b>
<b>Infertility / pregnancy test</b>	<b>296</b>	<b>0.3</b>	<b>0.2</b>	<b>0.3</b>	<b>68</b>	<b>0.4</b>	<b>0.0</b>	<b>0.8</b>
<b>Total pathology orders</b>	<b>44,439</b>	<b>41.6</b>	<b>40.2</b>	<b>43.0</b>	<b>6,131</b>	<b>32.6</b>	<b>28.7</b>	<b>36.5</b>

Encs=encounters; NEC=not elsewhere classified

**Table 4.21: Imaging tests by MBS group and most frequent tests ordered**

Imaging test ordered	GPs using a computer for clinical purposes				GPs not using a computer for clinical purposes			
	Number	Rate per 100 encounters (n=106,900)	95% LCL	95% UCL	Number	Rate per 100 encounters (n=18,800)	95% LCL	95% UCL
<b>Diagnostic radiology</b>	<b>4,925</b>	<b>4.6</b>	<b>4.4</b>	<b>4.8</b>	<b>895</b>	<b>4.8</b>	<b>4.1</b>	<b>5.4</b>
X-ray; chest	1,099	1.0	1.0	1.1	196	1.0	0.8	1.3
X-ray; knee	463	0.4	0.4	0.5	86	0.5	0.3	0.6
Mammography; F	433	0.4	0.4	0.5	67	0.4	0.2	0.5
X-ray; foot / feet	257	0.2	0.2	0.3	41	0.2	0.1	0.3
X-ray; hip	238	0.2	0.2	0.3	36	0.2	0.1	0.3
Test; densitometry	228	0.2	0.2	0.2	33	0.2	0.1	0.3
X-ray; ankle	225	0.2	0.2	0.2	46	0.2	0.1	0.3
X-ray; shoulder	218	0.2	0.2	0.2	39	0.2	0.1	0.3
X-ray; wrist	187	0.2	0.1	0.2	31	0.2	0.1	0.2
X-ray; spine; lumbosacral	182	0.2	0.1	0.2	33	0.2	0.1	0.2
X-ray; spine; cervical	130	0.1	0.1	0.1	17	0.1	0.0	0.1
X-ray; hand	129	0.1	0.1	0.1	32	0.2	0.1	0.2
X-ray; spine; lumbar	103	0.1	0.1	0.1	22	0.1	0.1	0.2
<b>Ultrasound</b>	<b>3,107</b>	<b>2.9</b>	<b>2.8</b>	<b>3.0</b>	<b>454</b>	<b>2.4</b>	<b>2.1</b>	<b>2.8</b>
Ultrasound; pelvis	601	0.6	0.5	0.6	79	0.4	0.3	0.6
Ultrasound; abdomen	326	0.3	0.3	0.3	64	0.3	0.2	0.4
Ultrasound; breast;F	320	0.3	0.3	0.3	39	0.2	0.1	0.3
Ultrasound; obstetric	289	0.2	0.2	0.3	30	0.2	0.1	0.3
Ultrasound; shoulder	253	0.2	0.2	0.3	41	0.2	0.1	0.3
Test; doppler	134	0.1	0.1	0.1	17	0.1	0.0	0.1
<b>Computerised tomography</b>	<b>1,028</b>	<b>1.0</b>	<b>0.9</b>	<b>1.0</b>	<b>169</b>	<b>0.9</b>	<b>0.7</b>	<b>1.1</b>
CT scan; brain	208	0.2	0.2	0.2	27	0.1	0.1	0.2
CT scan; abdomen	122	0.1	0.1	0.1	20	0.1	0.1	0.2
CT scan; spine; lumbosacral	100	0.1	0.1	0.1	25	0.1	0.1	0.2
<b>Nuclear medicine imaging</b>	<b>112</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>	<b>15</b>	<b>0.1</b>	<b>0.0</b>	<b>0.1</b>
<b>Magnetic resonance imaging</b>	<b>42</b>	<b>0.0</b>	<b>0.0</b>	<b>0.1</b>	<b>4</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>
<b>Total imaging orders</b>	<b>9,124</b>	<b>8.6</b>	<b>8.3</b>	<b>8.9</b>	<b>1,537</b>	<b>8.2</b>	<b>7.2</b>	<b>9.1</b>

The above analyses show realistically the comparison between GPs who use computers in their clinical activity and those who do not. Clinical computer users differ in many respects from their non clinical computer user counterparts in terms of their personal and practice characteristics. These differences have in turn attracted different types of patients with different reasons for seeking an encounter with the GP. Together these differences have resulted in different morbidities being managed, and different management patterns for the problems seen by clinical computer users and non clinical computer users.

These differences are likely to exist because of factors other than the GPs' use of computers – their age, the size of practice in which they work, are just as likely to influence these outcomes. Similarly, the mix of patients and the morbidities they have will be influenced by characteristics of the GP and the practice, and it turn, the morbidity the patients have will influence the management techniques employed by the GPs.

The extent to which the differences shown in the above section are determined by GP (clinical) computer use, or can be explained by other characteristics, are investigated and presented below.

### **Univariate and multivariate analysis**

Results of univariate analyses are shown in Tables 4.22-4.33.

#### **4.2.8 Patient characteristics by GP clinical computer use status after adjustment (Model 4A)**

Outcome variables were compared after adjustment for GP and practice characteristics as per Model 4A, and only one of the patient characteristics remained significantly different. Clinical computer users saw significantly fewer patients who were holders of a Commonwealth Health Care Benefits Card (OR=0.89,  $p=0.035$ ) (Table 4.22) than non clinical computer users.

**Table 4.22: Univariate and multivariate analysis of patients' characteristics**

Outcome variable – Patient characteristic	Unadjusted			Adjusted <sup>(a)</sup>		
	Odds ratio GPs not using computer: GPs using computer for clinical purpose	95% CI	P	Odds ratio GPs not using computer : GPs using computer for clinical purpose	95% CI	P
Male patients	0.84	0.78-0.91	<0.001	0.95	0.88-1.03	0.23
C'wealth conc. card	0.78	0.68-0.90	0.001	0.83	0.70-0.99	0.035
VA card holder	1.14	0.94-1.39	0.19	1.04	0.77-1.40	0.79
NESB	0.51	0.36-0.72	<0.001	1.20	0.82-1.77	0.35
Aboriginal and/or Torres strait islander	0.78	0.37-1.66	0.52	0.79	0.30-2.09	0.64
New to practice	0.77	0.61-0.97	0.02	0.81	0.61-1.06	0.12
Regression coefficient computerised vs non-computerised GPs <sup>(a)</sup>	95% CI		P	Regression coefficient	95% CI	P
Age	-1.80	-3.30 - -0.29	0.019	-0.70	-2.47-1.07	0.44

(a): model A: Controlling for the following GP/practice characteristics other than GPs using computer for clinical purpose status: sex, age, fellowship of RACGP status, working in a deputising service over the past four weeks, bulk billing all patients status, practice accreditation status, practice nurse at major practice. C'wealth conc. card = Health care/benefits card.

#### 4.2.9 Patient reasons for encounter by GP clinical computer use status after adjustment (Model 4B)

The descriptive analysis in Table 4.10 showed that patients attending a clinical computer user were more likely to present for test results or for preventive immunisations/vaccinations, and less likely to attend for hypertension management. A number of other reasons for encounter that were marginal in the descriptive analysis were found to be significantly different once *p* values were produced through univariate analyses (Table 4.23). Patients attending a clinical computer user were less likely to attend for back complaint and headache, and more likely to attend for general check-up, female genital check-up, or for administrative procedures.

After adjustment, however, the only differences remaining between the two groups that could be attributed to the use of a computer were for patients presenting for test results (OR=1.20, *p*=0.045) and for those with hypertension/high blood pressure (OR=0.67, *p*=0.03).

**Table 4.23: Univariate and multivariate analysis of most frequent individual RFEs**

outcome variable – (rates) Presence of individual RFE	Unadjusted			Adjusted <sup>(a)</sup>		
	Odds ratio GPs not using computer: GPs using computer for clinical purpose	95% CI	P	Odds ratio GPs not using computer: GPs using computer for clinical purpose	95% CI	P
Prescription all*	0.94	0.80-1.10	0.44	0.97	0.81-1.16	0.74
Test results*	1.33	1.13-1.56	0.001	1.20	1.00-1.43	0.045
Cough	0.98	0.86-1.13	0.82	1.11	0.95-1.30	0.17
Preventive immun/vacc/meds-all*	1.52	1.14-2.01	0.004	1.41	0.99-2.00	0.06
Cardiac check-up*	0.89	0.75-1.06	0.20	0.97	0.80-1.19	0.80
General check-up*	1.25	1.03-1.52	0.024	1.10	0.88-1.36	0.40
Back complaint*	0.83	0.71-0.98	0.024	0.94	0.80-1.10	0.41
Throat complaint	0.88	0.74-1.04	0.12	1.01	0.84-1.22	0.91
Rash*	1.00	0.84-1.20	0.97	1.09	0.91-1.32	0.35
Fem genital check-up*	1.59	1.10-2.29	0.013	1.00	0.72-1.40	0.98
Depression*	1.04	0.86-1.25	0.70	0.86	0.70-1.07	0.18
Abdominal pain*	0.99	0.84-1.16	0.91	1.05	0.86-1.28	0.65
Admin procedure NOS	1.28	1.02-1.60	0.03	1.10	0.86-1.41	0.44
Weakness/tiredness	1.05	0.83-1.34	0.67	1.05	0.70-1.56	0.82
URTI	1.08	0.85-1.38	0.52	1.03	0.79-1.35	0.82
Hypertension/high BP	0.64	0.48-0.84	0.001	0.67	0.47-0.96	0.03
Ear pain	1.07	0.90-1.28	0.45	1.00	0.82-1.21	0.98
Fever	0.89	0.65-1.22	0.47	0.95	0.66-1.36	0.76
Skin complaint	0.88	0.62-1.24	0.47	0.90	0.63-1.28	0.55
Headache	0.76	0.63-0.93	0.008	0.88	0.69-1.12	0.29

(a): model B: Controlling for: GP sex, GP age, fellowship of RACGP status, working in a deputising service over the past four weeks, bulk billing all patients status, practice accreditation status. URTI = upper respiratory tract infection \* Includes multiple ICPC-2 or ICPC-2 PLUS codes

#### **4.2.10 Morbidity managed by GP clinical computer use status after adjustment (Model 4B)**

Although GPs using computers for clinical purposes were found to manage more problems per 100 encounters than non clinical computer users in the descriptive analyses (150.5 per 100, 95% CI:148.8-152.2 cf. 144.1 per 100, 95% CI: 140.1-148.1), this difference was no longer apparent after adjustment (RC=3.44,  $p=0.12$ ) (results tabulated in Chapter 5, Table 5.1).

As previously reported, the problems managed at the encounter were compared for both GP groups on the basis of the presence or absence of each ICPC-2 chapter, after adjustment for both GP and patient characteristics (Model B).

##### **Problems managed by ICPC-2 chapter**

Descriptive results of problems managed by ICPC-2 Chapter were reported in Table 4.12, showing a significant difference between the GP groups in the proportion of encounters where problems managed were of a general or unspecified nature, associated with the female genital system, or associated with pregnancy or family planning. Once  $p$  values were produced through univariate analyses, two other differences became significant. Clinical computer users managed significantly more problems associated with the urological system (OR=1.18,  $p=0.009$ ), or of a social nature (OR=1.45,  $p=<0.009$ ).

All of these differences disappeared after adjustment, indicating that the differences were explained by characteristics of the two GP groups and their patients, rather than being a result of computer use (Table 4.24).

**Table 4.24: Univariate and multivariate analysis of problems managed by ICPC-2 chapter**

outcome variable – (rates) Presence of problem managed (ICPC-2 chapter)	Unadjusted			Adjusted <sup>(a)</sup>		
	Odds ratio GPs not using computer for clinical purpose : GPs using computer for clinical purpose	95% CI	P	Odds ratio GPs not using computer for clinical purpose : GPs using computer for clinical purpose	95% CI	P
Respiratory	1.07	0.97-1.18	0.20	1.09	0.97-1.22	0.15
Skin	0.99	0.82-1.18	0.89	1.02	0.84-1.24	0.85
Musculoskeletal	1.00	0.91-1.11	0.98	1.02	0.92-1.13	0.68
General & unspecified	1.33	1.16-1.53	<0.001	1.16	0.99-1.35	0.06
Circulatory	0.90	0.80-1.01	0.067	0.96	0.85-1.08	0.52
Psychological	0.98	0.85-1.12	0.73	0.94	0.82-1.08	0.38
Endocrine & metabolic	0.98	0.87-1.11	0.80	1.01	0.90-1.15	0.83
Digestive	0.99	0.91-1.07	0.79	0.99	0.91-1.09	0.86
Female genital system	1.37	1.10-1.71	0.005	1.06	0.86-1.24	0.75
Pregnancy & family planning	1.40	1.07-1.84	0.014	1.00	0.79-1.26	1.00
Ear	1.08	0.85-1.39	0.53	0.97	0.80-1.19	0.80
Neurological	1.02	0.91-1.15	0.76	1.03	0.91-1.17	0.62
Urology	1.18	1.04-1.34	0.009	1.13	0.98-1.30	0.09
Eye	1.02	0.90-1.16	0.71	1.11	0.96-1.29	0.16
Blood/blood forming organs	1.16	0.95-1.42	0.15	1.31	0.89-1.93	0.17
Male genital system	0.94	0.69-1.27	0.68	0.90	0.69-1.17	0.44
Social	1.45	1.10-1.91	0.009	1.09	0.79-1.51	0.60

(a): model B: Controlling for the following GP/practice characteristics other than GPs using computer for clinical purpose status: sex, age, fellowship of RACGP status, working in a deputising service over the past four weeks, bulk billing all patients status, practice accreditation status, practice nurse at major practice; and patient characteristics: sex, age, holding health care card, holding veteran affairs card, Non English Speaking background, aboriginal and/or Torres Strait Islander, new to practice.

### Individual problems managed

The results of descriptive analyses for the relative frequencies of the most common individual problems managed were reported earlier in Table 4.13. In Table 4.25, some new differences were observed which became significant once *p* values were produced through univariate analyses.

In addition to the differences in management rates for hypertension, recording of a 'prescription' as the problem being managed, female genital check-up, and general check-up, compared with non clinical computer users, those using computers for clinical activity managed:

- significantly more asthma (OR=1.19,  $p=0.02$ )
- significantly more urinary tract infections (OR=1.20,  $p=0.041$ ), and
- significantly more oral contraception problems (OR=1.37,  $p=0.004$ )
- significantly more cardiac check-ups (OR=1.56,  $p=0.004$ )

The significant difference in the management rate of hypertension was the only difference to remain after adjustment (OR=0.86,  $p=0.044$ ), however a new difference emerged. Clinical computer users managed significantly more ischaemic heart disease at the encounter than non clinical computer users (OR=1.36,  $p=0.017$ ). No other new significant differences emerged between the two GP groups (Table 4.25).

**Table 4.25: Univariate and multivariate analysis of the problems managed**

Outcome variable – presence of problem managed (rates)	Unadjusted			Adjusted <sup>(a)</sup>		
	Odds ratio GPs not using computer for clinical purpose : GPs using computer for clinical purpose	95% CI	P	Odds ratio GPs not using computer for clinical purpose : GPs using computer for clinical purpose	95% CI	P
Hypertension*	0.78	0.70-0.89	<0.001	0.86	0.75-1.00	0.044
Preventive immun/vacc/meds-all*	1.37	0.96-1.94	0.08	1.26	0.85-1.88	0.25
Acute upper respiratory infection (URTI)	0.98	0.84-1.14	0.76	1.02	0.86-1.20	0.82
Depression*	1.07	0.92-1.24	0.37	0.89	0.76-1.04	0.15
Lipid disorders*	0.95	0.80-1.12	0.53	1.05	0.87-1.28	0.59
Diabetes*	0.87	0.74-1.03	0.11	1.01	0.85-1.20	0.92
Back complaint*	1.04	0.87-1.24	0.68	0.99	0.83-1.17	0.89
Osteoarthritis*	1.07	0.90-1.27	0.44	1.14	0.95-1.37	0.15
Prescription all*	1.44	1.08-1.93	0.012	1.24	0.80-1.90	0.33
Female genital check-up*	1.52	1.04-2.21	0.03	0.97	0.69-1.37	0.87
Asthma	1.19	1.03-1.38	0.02	1.15	0.97-1.37	0.11
General check-up*	1.57	1.20-2.05	0.001	1.24	0.90-1.70	0.18
Oesophageal disease	1.06	0.88-1.28	0.55	1.08	0.88-1.32	0.47
Acute bronchitis/bronchiolitis	1.01	0.82-1.23	0.94	0.96	0.75-1.24	0.75

(continued)

**Table 4.25 (continued): Univariate and multivariate analysis of the problems managed**

outcome variable - presence of problem managed (rates)	Unadjusted			Adjusted <sup>(a)</sup>		
	Odds ratio GPs not using computer for clinical purpose : GPs using computer for clinical purpose	95% CI	P	Odds ratio GPs not using computer for clinical purpose : GPs using computer for clinical purpose	95% CI	P
Anxiety*	0.87	0.71-1.07	0.20	0.91	0.72-1.14	0.40
Contact dermatitis	1.05	0.91-1.22	0.51	1.13	0.95-1.35	0.16
Urinary tract infection*	1.20	1.01-1.42	0.041	1.07	0.89-1.30	0.47
Sleep disturbance	1.10	0.90-1.36	0.36	1.17	0.94-1.46	0.17
Sprain/strain	0.87	0.70-1.08	0.20	1.03	0.82-1.30	0.78
Oral contraception*	1.37	1.10-1.70	0.004	1.05	0.83-1.31	0.70
Test results*	1.25	0.98-1.58	0.07	1.11	0.87-1.41	0.39
Solar keratosis/sunburn	0.59	0.33-1.04	0.07	0.74	0.42-1.32	0.31
Ischaemic heart disease*	1.20	0.96-1.50	0.11	1.36	1.06-1.75	0.017
Malignant neoplasm skin	0.62	0.37-1.04	0.07	0.77	0.43-1.35	0.36
Other viral disease NOS	1.24	0.94-1.65	0.13	1.23	0.90-1.68	0.19
Acute/chronic sinusitis	1.06	0.86-1.30	0.58	0.98	0.76-1.26	0.88
menopausal complaint/symptom	1.30	1.00-1.68	0.050	1.14	0.85-1.53	0.37
Acute otitis media/myringitis	1.14	0.91-1.42	0.25	0.88	0.68-1.14	0.34
Cardiac check-up*	1.56	1.16-2.09	0.004	1.16	0.81-1.67	0.42
Fracture*	0.91	0.47-1.75	0.77	1.15	0.53-2.49	0.72
Tonsillitis*	1.11	0.87-1.40	0.41	0.98	0.73-1.31	0.90
Presumed gastroenteritis, infection	0.83	0.66-1.05	0.12	0.88	0.68-1.14	0.32
Skin disease, other	0.90	0.63-1.29	0.58	1.02	0.70-1.48	0.93
Injury musculoskeletal NOS	0.82	0.60-1.11	0.19	0.88	0.66-1.17	0.38

(a): model B: Controlling for the following GP/practice characteristics other than GPs using computer for clinical purpose status: sex, age, fellowship of RACGP status, working in a deputising service over the past four weeks, bulk billing all patients status, practice accreditation status, practice nurse at major practice; and patient characteristics: sex, age, holding health care card, holding veteran affairs card, Non English Speaking background, aboriginal and/or Torres Strait Islander, new to practice. \* Includes multiple ICPC-2 or ICPC-2 PLUS codes

#### **4.2.11 Management of problems by GP clinical computer use status after adjustment (Model 4C)**

The proportion of encounters at which at least one of a range of management events could occur were compared between clinical computer users and non clinical computer users and the descriptive results shown in Table 4.14. Again, at the univariate level, once  $p$  values were produced some other marginal difference became apparent (Table 4.26). In addition to the previously reported differences in rates of prescribe medications, overall investigations, and pathology orders, clinical computer users:

- were less likely to record at least one treatment of any type (OR=0.85,  $p=0.019$ ) and
- were less likely to prescribe/advise/provide at least one medication (OR=0.87,  $p=0.021$ )

However, after adjustment for the characteristics of the GP, the practice, the patient, and the morbidity managed (Model C), all the differences apparent in the univariate analysis disappeared, and one new difference emerged. Compared to non clinical computer users, those using computers for clinical activity recorded significantly fewer referrals to allied health professionals at the encounter (OR=0.81,  $p=0.03$ ).

**Table 4.26: Univariate and multivariate analysis of management activities at the encounter**

Outcome variable - at least one management type	Unadjusted			Adjusted <sup>(a)</sup>		
	Odds ratio GPs not using computer for clinical purpose : GPs using computer for clinical purpose	95% CI	P	Odds ratio GPs not using computer for clinical purpose : GPs using computer for clinical purpose	95% CI	P
<b>Treatment, referral or investigation</b>	0.87	0.71-1.06	0.18	0.86	0.68-1.08	0.20
<b>1 + treatment type</b>	0.85	0.74-0.97	0.019	0.89	0.76-1.04	0.14
<b>1 + medication</b>	0.87	0.77-0.98	0.021	0.90	0.79-1.01	0.08
1 + prescription	0.85	0.76-0.96	0.007	0.91	0.81-1.03	0.12
1 + OTC advised	0.98	0.82-1.16	0.78	0.85	0.70-1.03	0.09
1 + GP supplied	1.14	0.88-1.47	0.33	1.02	0.76-1.35	0.92
<b>1 + non- pharmacological treatment</b>	1.01	0.87-1.18	0.89	0.92	0.77-1.09	0.34
1 + clinical treatment	1.00	0.85-1.17	0.99	0.90	0.75-1.08	0.26
1 + therapeutic procedure	0.98	0.83-1.17	0.83	0.94	0.79-1.10	0.44
<b>1 + referral</b>	1.07	0.96-1.19	0.24	0.90	0.80-1.01	0.06
1 + referral to specialist	1.11	0.99-1.25	0.07	1.00	0.88-1.13	0.99
1 + referral to allied health service	1.10	0.91-1.34	0.32	0.81	0.67-0.98	0.03
1 + referral to hospital	0.77	0.51-1.14	0.19	0.81	0.46-1.40	0.45
1 + referral to emergency dept	0.74	0.43-1.30	0.30	0.66	0.37-1.18	0.16
<b>1 + investigation</b>	1.21	1.08-1.34	0.001	0.98	0.87-1.11	0.78
1 + pathology order	1.22	1.07-1.39	0.002	0.97	0.84-1.12	0.68
1 + imaging order	1.09	0.96-1.23	0.19	0.97	0.84-1.11	0.64
1 + other investigation	1.23	0.96-1.57	0.10	1.04	0.78-1.38	0.80

(a): model C: Controlling for the following GP/practice characteristics other than GPs using computer for clinical purpose status: sex, age, fellowship of RACGP status, working in a deputising service over the past four weeks, bulk billing all patients status, practice accreditation status, practice nurse at major practice; and patient characteristics: sex, age, holding health care card, holding veteran affairs card, Non English Speaking background, aboriginal and/or Torres Strait Islander, new to practice, and presence of problems managed by ICPC-2 chapter at the encounter.

### Management with prescribed medication by GP clinical computer use status after adjustment (Model 4C)

In Section 4.2.7 (Table 4.15) the distribution of prescribed medications across groups and sub-groups was compared for the two GP groups. The unadjusted odds ratios in Table 4.27 compare the proportion of encounters at which at least one of the specific medication groups, subgroups, or generics, were prescribed by the two GP groups. At this level of analysis, clinical computer users were found to prescribe significantly fewer:

- cardiovascular drugs (OR=0.84,  $p=0.015$ ), particularly ...
  - antihypertensives (OR=0.79,  $p=0.002$ ), specifically ...
    - ramipril (OR=0.78,  $p=0.049$ )
  - beta blockers (OR=0.77,  $p=0.008$ )
- tetracyclines (OR=0.80,  $p=0.047$ )
- medications acting on the central nervous system (OR=0.78,  $p<0.001$ ), particularly ...
  - simple analgesic (OR=0.69,  $p<0.001$ ), specifically ...
    - paracetamol (OR=0.67,  $p<0.001$ )
- antiemetics / antinauseants (OR=0.82,  $p=0.046$ )
- anxiolitics (OR=0.72,  $p=0.006$ ), specifically ...
  - diazepam (OR=0.69,  $p=0.006$ )
- hypoglycaemic agents (OR=0.71,  $p=0.001$ )
- musculoskeletal agents (OR=0.80,  $p<0.001$ ), particularly ...
  - non-steroidal anti-inflammatory drugs (OR=0.82,  $p=0.003$ ), specifically ...
    - diclofenac sodium systemic (OR=0.76,  $p=0.01$ )
- medications acting on the digestive system (OR=0.87,  $p=0.032$ ).

In contrast, clinical computer users prescribed significantly more:

- contraceptives (OR=1.49,  $p<0.001$ ), particularly ...
  - oral, systemic (OR=1.48,  $p=0.001$ ), specifically ...
    - levonorgestrel / ethinyloestradiol (OR=1.39,  $p=0.004$ ).

After adjusting for GP and practice characteristics, patient characteristics, and morbidity managed at the encounter (Model C) few significant differences remained. GPs using computers for clinical purposes prescribed fewer:

- antihypertensives (OR=0.82,  $p=0.033$ ), specifically ...
  - ramipril (OR=0.73,  $p=0.037$ )
- beta blockers (OR=0.79,  $p=0.022$ )
- simple analgesics (OR=0.77,  $p=0.017$ ), specifically ...
  - paracetamol (OR=0.75,  $p=0.022$ )

- hormones (OR=0.86,  $p=0.036$ ), particularly ...
  - hypoglycaemic agents (OR=0.78,  $p=0.039$ )
- musculoskeletal agents (OR=0.80,  $p=0.005$ , particularly ...
  - non-steroidal anti-inflammatory drugs (OR=0.82,  $p=0.022$ )

One new difference emerged, that being a significantly lower prescribing rate of hormones (as included above) by clinical computer users (OR=0.86,  $p=0.036$ ). All other differences between the two groups were no longer apparent.

**Table 4.27: Univariate and multivariate analysis of the most common medications prescribed, by group, subgroup and generic medication**

Outcome variable – at least one medication prescribed			Unadjusted			Adjusted <sup>(a)</sup>		
Group	Sub group	Generic	Odds ratio GPs not using computer for clinical purpose : GPs using computer for clinical purpose	95% CI	P	Odds ratio GPs not using computer for clinical purpose : GPs using computer for clinical purpose	95% CI	P
Cardiovascular			0.84	0.73-0.97	0.015	0.90	0.76-1.07	0.23
	Antihypertensives		0.79	0.68-0.92	0.002	0.82	0.68-0.98	0.033
		Irbesartan	0.82	0.66-1.03	0.09	0.96	0.76-1.22	0.76
		Perindopril	0.83	0.65-1.06	0.13	0.91	0.69-1.21	0.53
		Ramipril	0.78	0.60-1.00	0.049	0.73	0.55-0.98	0.037
	Other CVS drugs		0.91	0.77-1.07	0.24	1.00	0.83-1.20	0.96
		Atorvastatin	0.87	0.71-1.08	0.21	0.93	0.74-1.17	0.53
		Simvastatin	0.97	0.79-1.20	0.79	1.10	0.86-1.41	0.43
	Beta-blockers		0.77	0.64-0.93	0.008	0.79	0.65-0.97	0.022
		Atenolol	0.81	0.65-1.01	0.058	0.79	0.63-1.01	0.06
Anti-infections/infestations			0.97	0.88-1.08	0.60	0.93	0.82-1.06	0.29
	Broad spectrum penicillins		0.90	0.78-1.03	0.13	0.89	0.75-1.06	0.20
		Amoxicillin	0.89	0.75-1.05	0.17	0.94	0.75-1.18	0.60
		Amoxicillin/potassium clavulanate	0.92	0.75-1.12	0.40	0.83	0.66-1.05	0.12
	Penicillin/Cephalosporins		1.06	0.93-1.21	0.37	1.05	0.89-1.24	0.56
		Cephalexin	1.19	1.00-1.42	0.046	1.15	0.92-1.44	0.23
	Other antibiotics		1.06	0.89-1.27	0.48	0.96	0.78-1.18	0.69
		Roxithromycin	0.90	0.70-1.15	0.39	0.91	0.68-1.20	0.50
	Anti-infectives		1.14	0.89-1.45	0.31	1.19	0.87-1.63	0.27
	Tetracyclines		0.80	0.64-1.00	0.047	0.78	0.60-1.02	0.07
		Doxycycline	0.84	0.65-1.08	0.17	0.83	0.62-1.12	0.22
CNS			0.78	0.68-0.89	<0.001	0.86	0.73-1.01	0.06
	Simple analgesics		0.69	0.57-0.83	<0.001	0.77	0.62-0.95	0.017
		Paracetamol	0.67	0.55-0.82	<0.001	0.75	0.59-0.96	0.022
		Aspirin	0.79	0.60-1.04	0.10	0.83	0.60-1.14	0.25

(continued)

**Table 4.27 (continued): Univariate and multivariate analysis of the most common medications prescribed, by group, subgroup and generic medication**

Outcome variable – at least one medication prescribed			Unadjusted			Adjusted <sup>(a)</sup>		
Group	Sub group	Generic	Odds ratio GPs not using computer for clinical purpose : GPs using computer for clinical purpose	95% CI	P	Odds ratio GPs not using computer for clinical purpose : GPs using computer for clinical purpose	95% CI	P
	Narcotic analgesics		0.92	0.71-1.20	0.55	1.12	0.83-1.52	0.46
	Tramadol		1.04	0.83-1.32	0.72	1.11	0.84-1.48	0.47
	Compound analgesic		0.84	0.70-1.00	0.052	0.81	0.65-1.01	0.064
	Paracetamol/ Codeine		0.83	0.68-1.02	0.069	0.78	0.61-1.00	0.052
	Antiemetic/ Antinauseant		0.82	0.68-1.00	0.046	0.88	0.69-1.12	0.28
Psychological			0.92	0.80-1.06	0.24	0.88	0.73-1.06	0.17
	Antidepressants		1.04	0.89-1.21	0.63	0.84	0.69-1.02	0.08
	Antianxiety		0.72	0.57-0.91	0.006	0.88	0.68-1.14	0.33
	Diazepam		0.69	0.53-0.90	0.006	0.90	0.68-1.19	0.46
	Sedatives/Hypnotics		1.06	0.89-1.26	0.51	1.12	0.90-1.40	0.32
	Temazepam		1.00	0.82-1.21	0.97	1.02	0.79-1.31	0.89
Hormones			0.91	0.80-1.04	0.17	0.86	0.74-0.99	0.036
	Hypoglycaemic		0.71	0.57-0.87	0.001	0.78	0.61-0.99	0.039
	Metformin		0.78	0.60-1.02	0.067	0.79	0.59-1.06	0.12
	Sex hormones/Anabolic		1.18	0.99-1.40	0.066	0.97	0.79-1.18	0.75
	Corticosteroids		0.97	0.79-1.18	0.74	0.83	0.64-1.07	0.15
Musculoskeletal			0.80	0.71-0.91	<0.001	0.80	0.68-0.93	0.005
	NSAID		0.82	0.72-0.93	0.003	0.82	0.69-0.97	0.022
	Celecoxib		0.93	0.74-1.16	0.52	0.79	0.63-1.00	0.051
	Diclofenac sodium systemic		0.76	0.61-0.94	0.01	0.86	0.66-1.13	0.29
Respiratory			1.02	0.89-1.18	0.77	1.03	0.87-1.23	0.71
	Bronchodilator/Spasm relaxant		1.00	0.85-1.18	0.96	0.90	0.74-1.10	0.30
	Salbutamol		0.97	0.82-1.16	0.75	0.91	0.74-1.12	0.37
	Asthma preventives		1.09	0.94-1.26	0.28	0.96	0.79-1.17	0.69
	Fluticasone/ Salmeterol		1.07	0.86-1.34	0.55	0.98	0.75-1.29	0.89

(continued)

**Table 4.27 (continued): Univariate and multivariate analysis of the most common medications prescribed, by group, subgroup and generic medication**

Outcome variable – at least one medication prescribed			Unadjusted			Adjusted <sup>(a)</sup>		
Group	Sub group	Generic	Odds ratio GPs not using computer for clinical purpose : GPs using computer for clinical purpose	95% CI	P	Odds ratio GPs not using computer for clinical purpose : GPs using computer for clinical purpose	95% CI	P
Skin			1.04	0.92-1.17	0.57	1.16	0.96-1.40	0.13
	Topical steroids		1.07	0.93-1.23	0.37	1.19	0.97-1.47	0.10
		Mometasone	1.24	0.96-1.58	0.094	1.32	0.96-1.82	0.09
		Betamethasone topical	1.09	0.86-1.37	0.48	1.21	0.90-1.63	0.21
Digestive			0.87	0.77-0.99	0.032	0.88	0.75-1.03	0.11
	Antiulcerants		0.92	0.80-1.07	0.29	0.90	0.75-1.08	0.27
		Esomeprazole	1.02	0.79-1.32	0.87	0.85	0.62-1.17	0.32
		Omeprazole	0.87	0.66-1.16	0.36	0.88	0.65-1.18	0.39
Allergy, immune system			1.16	0.91-1.47	0.22	1.00	0.76-1.32	0.99
	Immunization		1.31	0.97-1.77	0.08	1.10	0.79-1.54	0.58
		Influenza virus vaccine	1.18	0.71-1.98	0.52	1.06	0.61-1.82	0.85
Blood			0.95	0.78-1.14	0.56	0.95	0.78-1.16	0.64
	Other blood drugs		0.96	0.76-1.20	0.72	1.02	0.79-1.30	0.90
		Warfarin sodium	0.94	0.72-1.22	0.64	1.06	0.79-1.43	0.70
	Haemopoietics		0.92	0.71-1.20	0.55	0.82	0.61-1.10	0.19
Contraceptives			1.49	1.22-1.82	<0.001	1.00	0.76-1.32	0.99
	Contraceptives oral/systemic		1.48	1.21-1.81	<0.001	1.00	0.76-1.32	0.99
		Levonorgestrel/ Ethinylloestradiol	1.39	1.11-1.74	0.004	0.94	0.69-1.29	0.72
Urogenital			0.92	0.79-1.08	0.32	0.88	0.73-1.07	0.20
	Diuretic		0.84	0.68-1.04	0.11	0.80	0.65-1.01	0.060
Ear, nose topical			1.07	0.88-1.29	0.52	1.17	0.94-1.45	0.15
	Topical otic		1.00	0.79-1.26	0.99	1.11	0.86-1.44	0.41
Eye medications			0.93	0.80-1.09	0.38	0.97	0.77-1.22	0.80
	Anti-infectives eye		0.92	0.77-1.11	0.40	0.81	0.63-1.005	0.11
		Chloramphenicol eye	0.93	0.76-1.13	0.45	0.92	0.70-1.20	0.52

(continued)

**Table 4.27 (continued): Univariate and multivariate analysis of the most common medications prescribed, by group, subgroup and generic medication**

Outcome variable – at least one medication prescribed			Unadjusted			Adjusted <sup>(a)</sup>		
Group	Sub group	Generic	Odds ratio GPs not using computer for clinical purpose : GPs using computer for clinical purpose	95% CI	P	Odds ratio GPs not using computer for clinical purpose : GPs using computer for clinical purpose	95% CI	P
		Nutrition, metabolism	0.92	0.76-1.10	0.34	0.94	0.75-1.17	0.58
		Anti neoplastics	0.85	0.37-1.95	0.70	1.09	0.51-2.33	0.82
		Miscellaneous	0.82	0.59-1.14	0.23	0.82	0.53-1.25	0.35
		Surgical preparations	0.89	0.54-1.48	0.66	1.01	0.49-2.09	0.98
		Diagnostic agents	0.75	0.40-1.39	0.36	1.05	0.58-1.89	0.87

(a): model C: Controlling for the following GP/practice characteristics other than GPs using computer for clinical purpose status: sex, age, fellowship of RACGP status, working in a deputising service over the past four weeks, bulk billing all patients status, practice accreditation status, practice nurse at major practice; and patient characteristics: sex, age, holding health care card, holding veteran affairs card, Non English Speaking background, aboriginal and/or Torres Strait Islander, new to practice, and presence of problems managed by ICPC-2 chapter at the encounter.

### **Non-pharmacological management by GP clinical computer use status after adjustment (Model 4C)**

The descriptive analysis in Table 4.16 showed that clinical computer users provided counselling/advice for nutrition or weight problems significantly less often than their counterparts. Two other clinical treatments showing marginal difference in the descriptive analysis were found to be significantly different once *p* values were produced through univariate analyses (Table 4.28). Clinical computer users provided counselling for psychological problems more often, and undertook administrative/documentation work associated with the problem under management more frequently.

After adjustment only one significant difference remained that could be ascribed to clinical computer use. Clinical computer users provided counselling/advice for nutrition or weight problems significantly less often (OR=0.71, *p*=0.002).

**Table 4.28: Univariate and multivariate analysis of most frequent clinical treatments**

Clinical treatment	Unadjusted			Adjusted <sup>(a)</sup>		
	Odds ratio GPs not using computer for clinical purpose : GPs using computer for clinical purpose	95% CI	P	Odds ratio GPs not using computer for clinical purpose : GPs using computer for clinical purpose	95% CI	P
Advice / education*	0.97	0.75-1.24	0.78	0.86	0.64-1.15	0.32
Counselling - problem*	0.96	0.67-1.39	0.84	0.88	0.56-1.40	0.60
Counsel / advice – nutrition / weight*	0.71	0.57-0.88	0.002	0.71	0.57-0.89	0.002
Advice / education – treatment*	0.92	0.74-1.13	0.42	0.98	0.77	1.24
Advice / education – medication*	1.19	0.95-1.49	0.13	1.11	0.86-1.44	0.42
Counselling – psychological*	1.26	1.02-1.55	0.032	1.20	0.92-1.57	0.18
Counsel / advice – exercise*	0.87	0.61-1.25	0.46	0.84	0.61-1.17	0.31
Other admin / documentation*	1.46	1.11-1.93	0.007	1.22	0.89-1.68	0.22
Reassurance, support	1.04	0.74-1.45	0.83	1.18	0.79-1.75	0.41
Sickness certificate	1.35	0.88-2.07	0.17	1.06	0.73-1.54	0.75

(a): model C: Controlling for the following GP/practice characteristics other than GPs using computer for clinical purpose status: sex, age, fellowship of RACGP status, working in a deputising service over the past four weeks, bulk billing all patients status, practice accreditation status, practice nurse at major practice; and patient characteristics: sex, age, holding health care card, holding veteran affairs card, Non English Speaking background, aboriginal and/or Torres Strait Islander, new to practice, and presence of problems managed by ICPC-2 chapter at the encounter. \* Includes multiple ICPC-2 or ICPC-2 PLUS codes

### Procedural treatments by GP clinical computer use status after adjustment (Model 4C)

In Table 4.17 the descriptive analysis showed that clinical computer users provided significantly more preventive procedures. No other significant differences were observed from the univariate analysis (Table 4.29), however one new difference emerged after adjustment. Clinical computer users provided significantly fewer procedural treatments that involved physical medicine/rehabilitation (OR=0.76,  $p=0.043$ ).

**Table 4.29: Univariate and multivariate analysis of most frequent procedural treatments**

Procedural treatment	Unadjusted			Adjusted <sup>(a)</sup>		
	Odds ratio GPs not using computer for clinical purpose : GPs using computer for clinical purpose	95% CI	P	Odds ratio GPs not using computer for clinical purpose : GPs using computer for clinical purpose	95% CI	P
Local injection / infiltration*	1.03	0.74-1.44	0.86	1.01	0.70-1.46	0.96
Excision / removal tissue / biopsy / destruction / debridement / cauterisation*	0.77	0.50-1.19	0.24	0.86	0.63-1.18	0.36
Dressing / pressure / compression / tamponade*	1.17	0.94-1.45	0.16	1.16	0.86-1.56	0.33
Physical medicine / rehabilitation*	0.81	0.60-1.08	0.15	0.76	0.58-0.99	0.043
Pap smear*	1.41	0.80-2.46	0.23	0.90	0.57-1.40	0.64
Other therapeutic procedures / surgery NEC*	0.65	0.33-1.30	0.22	0.81	0.45-1.46	0.48
Incision / drainage / flushing / aspiration / removal body fluid*	1.01	0.82-1.24	0.91	0.83	0.64-1.07	0.15
Repair / fixation – suture / cast / prosthetic device (apply / remove)*	0.94	0.71-1.23	0.65	0.75	0.55-1.04	0.09
Other preventive procedures*	2.66	1.61-4.39	<0.001	1.61	0.98-2.65	0.063
Physical function test*	0.82	0.33-2.04	0.66	0.63	0.32-1.26	0.19
Glucose test	0.83	0.52-1.32	0.44	1.04	0.59-1.86	0.88

(a): model C: Controlling for the following GP/practice characteristics other than GPs using computer for clinical purpose status: sex, age, fellowship of RACGP status, working in a deputising service over the past four weeks, bulk billing all patients status, practice accreditation status, practice nurse at major practice; and patient characteristics: sex, age, holding health care card, holding veteran affairs card, Non English Speaking background, aboriginal and/or Torres Strait Islander, new to practice, and presence of problems managed by ICPC-2 chapter at the encounter. \* Includes multiple ICPC-2 or ICPC-2 PLUS codes

### Referrals by GP clinical computer use status after adjustment (Model 4C)

No significant differences between the two groups were observed from the descriptive analyses in the total referral rates, in the rates of referrals to medical specialists (Table 4.18) or to allied health professionals (Table 4.19). No other differences emerged in univariate analyses for referrals to medical specialists (Table 4.30).

Univariate analysis also showed no differences in the rates of referrals to allied health professionals (Table 4.31). However, following adjustment (Model C) two new differences emerged – clinical computer users provided significantly fewer referrals for counselling (OR=0.28,  $p=0.027$ ), and for rehabilitation (OR=0.28,  $p=0.001$ ). These individual differences account for the significant difference noted following adjustment in the overall rate of

referrals to allied health professionals (Table 4.26), where GPs using computers for clinical activity recorded significantly fewer referrals of this type (OR=0.81,  $p=0.03$ ).

**Table 4.30: Univariate and multivariate analysis of most frequent referrals to medical specialists**

Medical specialists	Unadjusted			Adjusted <sup>(a)</sup>		
	Odds ratio GPs not using computer for clinical purpose : GPs using computer for clinical purpose	95% CI	P	Odds ratio GPs not using computer for clinical purpose : GPs using computer for clinical purpose	95% CI	P
Referral; surgeon	1.04	0.83-1.31	0.72	0.98	0.74-1.31	0.89
Referral; ophthalmologist	1.17	0.93-1.48	0.18	1.06	0.81-1.38	0.69
Referral; dermatologist	1.06	0.84-1.34	0.60	0.92	0.69-1.24	0.60
Referral; orthopaedic surgeon	1.05	0.81-1.37	0.69	0.90	0.69-1.19	0.48
Referral; gynaecologist	1.18	0.91-1.54	0.21	0.99	0.75-1.31	0.94
Referral; ENT	1.11	0.85-1.46	0.43	1.00	0.74-1.36	0.99
Referral; cardiologist	1.05	0.72-1.53	0.82	1.13	0.79-1.62	0.50
Referral; gastroenterologist	1.04	0.79-1.37	0.77	0.84	0.62-1.14	0.27
Referral; urologist	1.31	0.95-1.80	0.09	1.16	0.74-1.82	0.53
Referral; psychiatrist	0.95	0.64-1.42	0.81	0.93	0.60-1.45	0.75
Referral; neurologist	1.07	0.72-1.60	0.73	0.97	0.62-1.52	0.89

(a): model C: Controlling for the following GP/practice characteristics other than GPs using computer for clinical purpose status: sex, age, fellowship of RACGP status, working in a deputising service over the past four weeks, bulk billing all patients status, practice accreditation status, practice nurse at major practice; and patient characteristics: sex, age, holding health care card, holding veteran affairs card, Non English Speaking background, aboriginal and/or Torres Strait Islander, new to practice, and presence of problems managed by ICPC-2 chapter at the encounter.

**Table 4.31: Univariate and multivariate analysis of most frequent referrals to allied health professionals**

Allied health professionals	Unadjusted			Adjusted <sup>(a)</sup>		
	Odds ratio GPs not using computer for clinical purpose : GPs using computer for clinical purpose	95% CI	P	Odds ratio GPs not using computer for clinical purpose : GPs using computer for clinical purpose	95% CI	P
Referral; physiotherapist	1.04	0.78-1.38	0.79	0.83	0.63-1.09	0.17
Referral; psychologist	1.60	0.96-2.64	0.07	0.81	0.44-1.47	0.49
Referral; podiatrist/ chiropractist	1.30	0.89-1.88	0.18	0.90	0.61-1.32	0.59
Referral; dietitian/ nutritionist	1.47	0.82-2.65	0.20	1.09	0.56-2.13	0.80
Referral; dentist	0.87	0.59-1.29	0.49	1.13	0.72-1.78	0.58
Referral; acoustic testing	1.35	0.80-2.28	0.26	0.86	0.46-1.59	0.62
Referral; diabetes education	1.96	0.64-5.95	0.24	2.63	0.69-10.04	0.16
Referral; counsellor	0.81	0.34-1.97	0.65	0.28	0.09-0.86	0.027
Referral; mental health team	0.77	0.39-1.49	0.43	0.70	0.34-1.42	0.32
Referral; optometrist	0.91	0.49-1.69	0.76	0.77	0.38-1.58	0.48
Referral; drug & alcohol	0.68	0.29-1.57	0.37	0.82	0.26-2.60	0.73
Referral; rehabilitation	0.41	0.15-1.10	0.08	0.28	0.13-0.57	0.001

(a): model C: Controlling for the following GP/practice characteristics other than GPs using computer for clinical purpose status: sex, age, fellowship of RACGP status, working in a deputising service over the past four weeks, bulk billing all patients status, practice accreditation status, practice nurse at major practice; and patient characteristics: sex, age, holding health care card, holding veteran affairs card, Non English Speaking background, aboriginal and/or Torres Strait Islander, new to practice, and presence of problems managed by ICPC-2 chapter at the encounter.

### Pathology tests and imaging orders by GP clinical computer use status after adjustment (Model 4C)

As shown in the descriptive analysis (Table 4.20) clinical computer users ordered significantly more pathology tests overall, and chemistry tests (specifically tests for lipids, liver function tests, thyroid function tests), haematology tests, and microbiology tests (specifically urine MS&C tests and other microbiology tests). A number of other marginal observations in the descriptive analysis were found to be significantly different once *p* values were produced through univariate analyses (Table 4.32) – clinical computer users ordered significantly more:

- electrolyte, urea & creatinine tests (OR=1.33, *p*=0.035)
- ferritin tests (OR=1.52, *p*=0.016)
- C reactive protein tests (OR=1.88, *p*=0.001)
- full blood count tests (OR=1.26, *p*=0.027)
- tests classified as Immunology (OR=1.47, *p*=0.03)

and significantly fewer:

- tests classified as Histopathology (OR=0.51,  $p=0.036$ ), and
- histology; skin tests (OR=0.48,  $p=0.028$ ).

Following adjustment however, only one significant difference remained, that being the higher rate of ‘other’ microbiology tests ordered by clinical computer users (OR=1.81,  $p=0.002$ ). Also, the previously observed significant difference in the overall rate of pathology ordering between the two groups did not remain after adjustment (RC -0.11,  $p=0.96$ ) (tabulated in Chapter 5, Table 5.1).

In Table 4.21, there were no significant differences found between the two groups in the rate of imaging orders. At the univariate analysis, one difference became significant – clinical computer users ordered more ultrasounds than their counterparts (OR=1.21,  $p=0.017$ ) (Table 4.33). Following adjustment this difference was no longer apparent, but a new difference emerged. Clinical computer users ordered significantly fewer X-rays of the lumbar spine (OR=0.58,  $p=0.038$ ).

**Table 4.32: Univariate and multivariate analysis of most frequent pathology orders by MBS pathology groups**

Pathology test ordered	Unadjusted			Adjusted <sup>(a)</sup>		
	Odds ratio GPs not using computer: GPs using computer for clinical purpose	95% CI	P	Odds ratio GPs not using computer: GPs using computer for clinical purpose	95% CI	P
<b>Chemistry</b>	1.26	1.09-1.45	0.002	1.01	0.82-1.20	0.89
Lipids	1.29	1.08-1.53	0.004	1.08	0.89-1.32	0.43
Electrolyte, Urea & Creatinine	1.33	1.02-1.72	0.035	1.03	0.76-1.39	0.85
Liver function	1.40	1.13-1.74	0.002	1.17	0.90-1.15	0.24
Thyroid function	1.38	1.15-1.66	<0.001	1.03	0.85-1.26	0.74
Glucose/tolerance	1.13	0.92-1.39	0.23	0.91	0.72-1.15	0.43
Multibiochemical analysis	1.30	0.75-2.25	0.34	0.98	0.50-1.91	0.95
Ferritin	1.52	1.08-2.14	0.016	0.94	0.62-1.44	0.79
Chemistry; other	1.07	0.79-1.45	0.65	0.98	0.71-1.35	0.88
HbA1c	1.23	0.92-1.65	0.16	1.06	0.80-1.40	0.68
Hormone assay	1.23	0.86-1.77	0.26	0.96	0.60-1.53	0.85
Prostate specific antigen	1.10	0.84-1.43	0.50	0.76	0.54-1.07	0.12
C reactive protein	1.88	1.28-2.76	0.001	1.37	0.87-2.17	0.18
<b>Haematology</b>	1.22	1.02-1.46	0.029	0.99	0.80-1.23	0.94
Full blood count	1.26	1.03-1.54	0.027	1.00	0.78-1.29	0.98
Erythrocyte Sedimentation Rate	1.31	0.96-1.81	0.09	1.06	0.70-1.60	0.78
Coagulation	1.02	0.78-1.33	0.89	0.97	0.72-1.31	0.85
<b>Microbiology</b>	1.59	1.34-1.87	<0.001	1.19	0.97-1.45	0.10
Urine MC&S	1.35	1.11-1.65	0.002	1.01	0.79-1.30	0.93
Microbiology; other	2.50	1.78-3.53	<0.001	1.81	1.24-2.65	0.002
Hepatitis serology	1.47	0.93-2.32	0.10	1.19	0.68-2.08	0.53
<b>Cytopathology</b>	1.49	1.00-2.24	0.051	0.86	0.64-1.18	0.36
Pap smear	1.50	0.99-2.25	0.053	0.87	0.64-1.19	0.39
<b>Other NEC</b>	0.74	0.55-1.00	0.052	0.82	0.57-1.17	0.27
Blood test	0.63	0.35-1.13	0.12	0.89	0.44-1.83	0.76
<b>Histopathology</b>	0.51	0.27-0.96	0.036	0.68	0.39-1.16	0.16
Histology; skin	0.48	0.25-0.92	0.028	0.67	0.39-1.17	0.16
<b>Immunology</b>	1.47	1.04-2.09	0.03	1.02	0.69-1.52	0.93
<b>Infertility / pregnancy test</b>	0.75	0.24-2.33	0.62	1.22	0.54-2.76	0.63

(a): model C: Controlling for the following GP/practice characteristics other than GPs using computer for clinical purpose status: sex, age, fellowship of RACGP status, working in a deputising service over the past four weeks, bulk billing all patients status, practice accreditation status, practice nurse at major practice; and patient characteristics: sex, age, holding health care card, holding veteran affairs card, Non English Speaking background, aboriginal and/or Torres Strait Islander, new to practice, and presence of problems managed by ICPC-2 chapter at the encounter. Encs=encounters; NEC=not elsewhere classified

**Table 4.33: Univariate and multivariate analysis of most frequent imaging tests by MBS group and most frequent tests ordered**

Imaging test ordered	Unadjusted			Adjusted <sup>(a)</sup>		
	Odds ratio GPs not using computer: GPs using computer for clinical purpose	95% CI	P	Odds ratio GPs not using computer: GPs using computer for clinical purpose	95% CI	P
<b>Diagnostic radiology</b>	0.97	0.84-1.14	0.74	0.87	0.72-1.04	0.13
X-ray; chest	0.99	0.79-1.23	0.90	0.92	0.69-1.23	0.59
X-ray; knee	0.95	0.69-1.30	0.73	0.88	0.64-1.22	0.44
Mammography; F	1.14	0.70-1.84	0.60	0.75	0.49-1.17	0.20
X-ray; foot / feet	1.10	0.78-1.56	0.58	1.04	0.72-1.49	0.84
X-ray; hip	1.16	0.80-1.69	0.43	1.05	0.69-1.61	0.82
Test; densitometry	1.22	0.77-1.92	0.40	0.96	0.56-1.64	0.88
X-ray; ankle	0.86	0.56-1.32	0.49	0.84	0.51-1.40	0.51
X-ray; shoulder	0.98	0.67-1.45	0.93	0.88	0.55-1.39	0.58
X-ray; wrist	1.06	0.68-1.66	0.80	0.85	0.49-1.50	0.58
X-ray; spine; lumbosacral	0.97	0.67-1.40	0.87	0.80	0.50-1.29	0.36
X-ray; spine;cervical	1.35	0.82-2.20	0.24	1.10	0.61-1.97	0.75
X-ray; hand	0.71	0.47-1.07	0.10	0.74	0.47-1.18	0.21
X-ray; spine; lumbar	0.82	0.49-1.37	0.46	0.58	0.34-0.97	0.038
<b>Ultrasound</b>	1.21	1.03-1.42	0.017	1.04	0.89-1.23	0.62
Ultrasound; pelvis	1.34	0.94-1.92	0.11	1.20	0.90-1.60	0.21
Ultrasound; abdomen	0.90	0.66-1.22	0.48	0.89	0.60-1.31	0.55
Ultrasound; breast;F	1.44	0.91-2.29	0.12	1.00	0.63-1.58	0.99
Ultrasound; obstetric	1.70	0.94-3.07	0.08	1.05	0.66-1.68	0.83
Ultrasound; shoulder	1.09	0.75-1.57	0.67	1.02	0.66-1.59	0.92
Test; doppler	1.39	0.77-2.50	0.28	1.38	0.70-2.73	0.35
<b>Computerised tomography</b>	1.07	0.87-1.32	0.52	1.02	0.79-1.31	0.91
CT scan; brain	1.36	0.86-2.15	0.20	1.42	0.79-2.57	0.24
CT scan; abdomen	1.07	0.63-1.83	0.80	1.07	0.63-1.83	0.80
CT scan; spine; lumbosacral	0.70	0.43-1.14	0.16	0.74	0.42-1.33	0.32
<b>Nuclear medicine imaging</b>	1.31	0.75-2.30	0.34	0.80	0.40-1.57	0.51
<b>Magnetic resonance imaging</b>	1.85	0.66-5.19	0.24	1.70	0.62-4.68	0.31

(a): model C: Controlling for the following GP/practice characteristics other than GPs using computer for clinical purpose status: sex, age, fellowship of RACGP status, working in a deputising service over the past four weeks, bulk billing all patients status, practice accreditation status, practice nurse at major practice; and patient characteristics: sex, age, holding health care card, holding veteran affairs card, Non English Speaking background, aboriginal and/or Torres Strait Islander, new to practice, and presence of problems managed by ICPC-2 chapter at the encounter.

## 5 Quality Indicators

As described in Chapter 1, a considerable amount of literature about computer use in health care settings supports the notion that computerisation will improve quality of care for patients, although there is little real evidence in support of this idea. In considering how computer use may affect the quality of care in general practice, evidence is needed to assess whether there are differences in the behaviour of GPs who use a computer for clinical purposes compared to those who do not.

In recent years the assessment and improvement of quality, and the demand for information on health care quality, has increased by health economists, policy makers, health professionals and consumers.(45) While this is an international trend, the approach to quality measurement, and the capacity to validly assess quality varies widely between countries.(46,47) This demand for quality assessment and improvement has given rise to the development of quality indicators.

A quality indicator has been defined by the European Working Party on Quality in Primary Care (EquiP) as: “A measurable element of practice performance for which there is evidence or consensus that it can be used to assess quality, and hence change in the quality, of care provided”.(48)

Quality indicators have been developed which are applicable to everything from prescribing, to monitoring programs, assessing interventions, to identifying poor performers.(45) Not all indicators are applicable in every situation, and the application of a quality indicator inappropriate to the situation in which it is used will invalidate the result. Creating meaningful indicators from accurate data is a challenging exercise,(49) and Pont et al argue that “face and content validity, on which validation has centred to date, are not adequate substitutes for concurrent validity, checking if an indicator adequately describes what can be observed in actual clinical practice”.(45) They use the example of creating prescribing indicators from computerized data such as sales records, claims data or pharmacy records to emphasize this point. If no indication is available to correspond to the prescribing data, this can result in misclassification and undermine the possibility of validly assessing the prescribing quality for a specific disease.(45)

The BEACH database on which this study is based, has been shown to be valid and reliable as a data source.(50) A previous analysis of BEACH data to compare GPs who hold Fellowship of the RACGP with those who do not, was undertaken in 2000.(43) For that study (referred to hereafter as the FRACGP study/report) a set of quality indicators were developed that were applicable to the BEACH data and could be used to assess quality of care by GPs or primary care physicians. These quality indicators have been adopted for this study. The original search of literature, databases, Australian and international guidelines undertaken to develop the quality indicators for the FRACGP study was thorough, and was performed only two years prior to the commencement of this study.(43)

However, a further literature search was undertaken to determine if there were any other indicators of quality published in the interim which may have been applicable for this analysis. PubMed, Medline and EMBASE were searched using terms such as ‘quality indicator’; ‘family practice’; ‘primary care’; ‘general practice’; ‘ambulatory care’; ‘standards’; ‘quality of health care’; ‘quality assurance health care’; ‘quality health outcomes’ in a variety of combinations. For the time frame requested, 47 responses resulted. Some articles were disease specific, specific to areas other than primary care, specific to systems that don’t exist in Australia, or ‘think pieces’ but any with indicators that may have been

applicable to primary care were considered.(45-47,51-57) Ultimately, there were no new indicators offered by these works that were suitable for use with the BEACH dataset, that had not previously been selected for the FRACGP study. The aim of this chapter is to determine whether the use of a computer for clinical purposes results in a 'higher' quality of care provided to patients.

## **5.1 Methods**

The methods utilised for this chapter are based on the BEACH methodology described in Chapter 2. As described in Chapter 3, the additional questions designed for the GP Profile questionnaire were used to investigate the clinical computer use of individual BEACH GPs. A set of 36 quality indicators validated in a previous study of BEACH data were used to compare the practice behaviour of GPs assigned to two groups according to their use of a computer for clinical purposes. As the assumption from many authors reviewed for this project is that the use of computers will improve health outcomes, the overall hypothesis is that clinical computer users will provided a better standard of care. The individual hypothesis and rationale for each of the domains of care were also based on this assumption and, on those developed for the FRACGP report.(43) The average length of consultation in minutes was investigated for a sub-sample of GPs in each group, in which the clinician had recorded the start time and finish time of each of 40 consultations. The GPs were then reassigned into groups according to their used of a computer for test ordering, and 8 of the quality indicators specifically applicable to test ordering behaviour were compared.

### **5.1.1 The participants**

The participants for this section were the 1,257 GPs for whom we were able to determine individual computer use status in Chapter 3. The sub-sets of consultations with start and finish time recorded included 34,633 consultations with clinical computer users and 6,084 consultations with non-clinical computer users.

**Test ordering** – because the denominator for clinical computer users included GPs who used a computer for any clinical purpose, there were a number of GPs in the computer use group who do not use the test ordering function of their clinical software. For this reason, we examined the test ordering behaviour for the total set of cliical computer users and their counterparts in the first instance, and then repeated the investigation for eight of the quality indicators (those specific to test ordering), with the GPs grouped according to their use of the test ordering function of their software. For these additional analyses, there were 901 GPs in the group who nominated test ordering as a clinical task for which they use a computer, and 356 in the group of GPs who did not use the computer for test ordering.

### **Definitions**

*Clinical computer use* was defined as the use of a computer for clinical functions e.g. prescribing and/or test ordering and/or medical records, with or without internet and/or email.

*Non-clinical computer use* was defined as the use of a computer for administrative functions, internet and/or email only. Clinical components of the medical software application such as prescribing, test ordering, medical records, while available, are not utilised by the GP in his clinical practice. GPs who did not use a computer at all were included in this group.

As in Chapter 4, the GPs who reported clinical computer use will be referred to in this Chapter as 'clinical computerised GPs' or 'clinical computer users'. There were 1,069 GPs in this group. The GPs who reported non-clinical computer use, or did not use a computer at all,

will be referred to in this Chapter as ‘non clinical computerised GPs’ or ‘non clinical computer users’. There were 188 GPs in this group.

The results for each indicator are described in full in the body of this chapter, including results from earlier chapters where necessary. The results of univariate and multivariate analyses are shown in Table 5.1(a), and a summary of all indicators, indicating acceptance or rejection of each hypothesis is provided in Table 5.2(a).

### **5.1.2 Multivariate analyses and Models used**

As the GPs being compared in this Chapter were assigned to the same groups as they had for Chapter 4, the same Models and covariates used in Chapter 4 were also used in this Chapter.

As the GPs were reallocated to groups according to their use of a computer for test ordering, the modelling process was again undertaken to determine what characteristics would require adjustment for in the logistic regression analysis.

NOTE: We have applied two different sets of models to the analyses for this Chapter. Models 4A – 4C are the models designed in Chapter 4 for clinical computer users versus non-clinical computer users and applied to the same GP groups in this Chapter. Models 5A – 5C were designed using the same process but a different set of characteristics were found to be associated with the dependent variable (GP computer use for test ordering).

**Co-variates in Model 5A** – the variables showing significant association ( $p < 0.05$ ) and included as covariates in the final model were:

- GP age
- GP sex
- Place of graduation
- GP status as a Fellow of the RACGP (FRACGP)
- Size of practice
- Practice location by ASGC
- Bulk-billing for all patients
- Practice accreditation status
- Presence of a practice nurse at the major practice address.

**Co-variates in Model 5B** – the variables showing significant association ( $P < 0.05$ ) and included as covariates in the final model were the GP and practice characteristics included in Model 5A, plus:

- Patient sex
- Patient age
- Commonwealth health care benefits card<sup>†</sup> holder status
- Veterans’ Affairs card holder status<sup>†</sup>
- Non-English speaking background status (NESB<sup>†</sup>)
- Aboriginal<sup>†</sup> or Torres Straight Islander<sup>†</sup> status
- Status of patient to the practice (i.e. new<sup>†</sup> or seen previously)

## **Covariates in model 6C**

- The GP, practice characteristics and patient characteristics included in Model 6B
- The presence or absence of problems managed by ICPC-2 Chapter at the encounter.

## **Group variable of interest**

For Models 4A – 4C the group variable was GP clinical computer use. GPs not using a computer for clinical purposes were the reference group against which the GPs using a computer for clinical purposes were compared.

For Models 5A – 5C the group variable was GP clinical computer use for test ordering. GPs not using a computer for test ordering were the reference group against which the GPs using a computer for test ordering were compared.

## **5.1.3 Statistical methods**

The denominator for each of the quality indicators for each of the GP groups is provided in Table 5.1(a), together with the rate of occurrence of the event expressed as a percentage of the denominator. The unadjusted linear regression coefficient (RC) is presented for comparison of the rates of the event in the two groups to show the raw difference between the rates. The Model used in the adjusted linear regression for each indicator is then presented, followed by the adjusted linear regression coefficient resulting after adjusting for the characteristics included in the named Models for each indicator.

## **5.2 Results**

### **5.2.1 Clinical computer users versus non clinical computer users**

The results for the comparison of clinical computer users vs non clinical computer users are shown in Table 5.1(a). The quality indicator for consultation time measured differences in the mean consultation length in minutes before and after adjustment, and other indicators measured the difference between rates of occurrence per 100 encounters or per 100 contacts as applicable. The Model used in the multivariate analysis is tabulated beside each indicator. The characteristics of the GP, practice, patient or morbidity included in each of the Models are listed in the footnotes.

### **Consultation patterns**

#### **Distribution of MBS items and mean length of consultation**

*Hypothesis:* Clinical computer users will spend more time with patients and this will be reflected in a greater proportion of long and prolonged consultations and in a longer mean consultation time.(43)

*Rationale:* Length of consultation has been identified as an important predictor or proxy for the quality of general practice care, particularly in relation to psychosocial problems, and leads to greater levels of patient satisfaction.(43)

#### **Distribution of Medicare item number**

*Results:* The univariate descriptive analysis demonstrated no significant difference between clinical computer users and non clinical computer users in the proportion of Medicare encounters designated as long consultations or prolonged consultations (Table 4.5). This result remained unchanged after adjustment ( $p=0.70$ ;  $p=0.76$  respectively) as shown in Table 5.1(a).

*Conclusion:* The hypothesis was rejected.

### **Length of consultation in minutes**

*Results:* The univariate descriptive analysis demonstrated no significant difference between clinical computer users and non clinical computer users in the mean length of consultation, both being 15 minutes (Table 4.4). This result remained unchanged after adjustment for GP, practice, patient and morbidity characteristics (Model 4C) ( $p=0.40$ ) as shown in Table 5.1(a).

*Conclusion:* The hypothesis was rejected.

### **Reasons for encounter and problems managed per 100 encounters**

*Hypothesis:* Clinical computer users will elicit more patient reasons for encounter, and therefore manage more problems at the encounter than non clinical computer users.

*Rationale:* As reported by Miller et al, the importance of patient-centred care in improving patient outcomes has been the subject of studies in the United States, Canada and the United Kingdom. It has been demonstrated that primary care physicians frequently fail to elicit all the patient's concerns and may thus leave problems unaddressed.(43) Patient-centred care will result in the GP eliciting more patient reasons for encounter, and detecting a larger number of patient problems. This will be reflected in a greater number of patient reasons for encounter and a greater number of problems managed at the encounter. (*Note:* this indicator is probably more valid as a patient based indicator which takes into account all problems being managed for the patient across an extended period rather than just those managed at a particular encounter.)(43)

#### **Reasons for encounter**

*Results:* The univariate descriptive analysis demonstrated no significant difference between clinical computer users and non clinical computer users in the number of patient reasons for encounter recorded (Table 4.6). This result remained unchanged after adjustment ( $p=0.82$ ) as shown in Table 5.1(a).

*Conclusion:* The hypothesis was rejected.

#### **Problems managed**

*Results:* The univariate descriptive analysis demonstrated that clinical computer users managed significantly more problems at the encounter (150.5 problems per 100 encounters, 95% CI: 148.8–152.2 cf. 144.1 per 100, 95% CI: 140.1–148.1;  $p=0.003$ ) that non clinical computer users (Table 4.6). Following adjustment there no longer remained a significant difference between the two groups ( $p=0.12$ ) (Table 5.1(a))

*Conclusion:* The hypothesis was rejected. Clinical computer users were shown to manage more problems per 100 encounters, but this difference was due to the influence of characteristics of the GPs other than their use of a computer for clinical activity.

### **Non-pharmacological management**

#### **Clinical treatment rates**

*Hypothesis:* Clinical computer users will provide counselling and advice about lifestyle, medication and problem management more often than non clinical computer users.

*Rationale:* A characteristic of patient-centred care and good preventive care is the provision of higher levels of counselling and advice regarding lifestyle and problem management.(43) The provision of preventive care in the form of lifestyle counselling (about diet, weight, exercise, smoking, alcohol intake etc) is an important part of general practice care and is supported by the guidelines issued by the RACGP. Advice about medications prescribed and

treatments given are also beneficial to the patient. The value of counselling for patients with depression and other psychological problems is also well supported in the literature and by initiatives such as Beyondblue.(43)

*Results:* There was no significant difference between clinical computer users and non clinical computer users in the rate of provision of clinical treatments overall, either in the univariate descriptive analysis ( $p=0.88$ ) or in the multivariate analysis ( $p=0.32$ ), as demonstrated in Table 5.1(a).

*Conclusion:* The hypothesis was rejected.

### **Therapeutic procedure rates**

*Hypothesis:* In addition to counselling and pharmacological managements, clinical computer users will provide more therapeutic procedures for their patients than non clinical computer users.

*Rationale:* Comprehensiveness of care is one of the hallmarks of good general practice and this is reflected in the RACGP curriculum for general practice vocational training and in the provision of continuing professional development programs by the College and ACRRM.(43)

*Results:* As shown in Table 5.1(a), there was no significant difference between clinical computer users and non clinical computer users in the relative rate of provision of procedural treatments, either in the univariate descriptive analysis ( $p=0.57$ ) or in the multivariate analysis ( $p=0.31$ ).

*Conclusion:* The hypothesis was rejected.

### **Prescribing rates**

*Hypothesis:* GPs who use a computer for clinical purposes will prescribe fewer medications per 100 encounters than GPs who do not use a computer for clinical activity.

*Rationale:* While there is good evidence for the belief that prescribing in certain conditions does not reflect best practice (for example, antibiotic prescribing for URTI), there is less evidence for the overall proposition that 'less prescribing is better'. However, such a view is often expressed in media and administrative comment. Pharmaceutical resource use is an undoubted financial problem in most parts of the world. It may therefore be argued that the opportunity cost of the current levels of prescribing is not in the public interest.(43)

*Results:* As demonstrated earlier (Table 4.6) the number of prescribed medications provided per 100 encounters was significantly less at encounters among clinical computer users (81.9, 95% CI: 80.1–83.7) than their counterparts (89.8, 95% CI: 83.9–95.7) ( $p=0.01$ ). Following adjustment, this result remained significantly different ( $p=0.02$ ) as shown in Table 5.1(a).

*Conclusion:* The hypothesis was accepted and the lower prescribing rate can be said to be the result of computer use.

### **Referrals**

*Hypothesis:* GPs who use a computer for clinical purposes will refer less often to hospitals and specialists but more frequently to allied health professionals than GPs who do not use a computer for clinical activity.(43)

*Rationale:* Better GPs should exhibit more comprehensive clinical and procedural skills, in line with those tested in the FRACGP exam, than non clinical computer users, and should thus need to call on the support services of specialists and hospitals less frequently. The

countervailing effects of medical indemnity problems may however limit the ability of GPs to undertake procedures even if they possess the required skills.

Conversely, the clinical computer users should be attuned to multi-disciplinary team care of their patients and thus use allied health professionals more frequently.(43)

*Results:* The univariate descriptive analysis demonstrated no significant difference between the GP groups in the overall rate of referrals (Table 4.6). No significant differences emerged from either the univariate or multivariate analyses in the rate of referrals to specialists or hospitals. There was also no significant difference between the GP groups in the univariate descriptive comparison for the rate of referrals to allied health professionals. However, after adjusting for other characteristics in the multivariate analysis, clinical computer users referred patients to allied health professionals at a significantly lower rate than GPs not using a computer for clinical activity ( $p=0.03$ ) (Table 5.1(a)).

*Conclusion:* The hypotheses regarding referral rates to hospitals and specialists was rejected at all levels of the analysis. For referral rates to allied health professionals, the difference remained following adjustment for other characteristics of the GP, and this difference was concluded to be entirely associated with the GPs' use of a computer for clinical activity. The hypothesis was rejected and reversed.

## **Tests and investigations**

*Hypothesis:* GPs who use a computer for clinical purposes will order less pathology, less imaging, and fewer investigations overall than GPs who do not use a computer for clinical activity.(43)

*Rationale:* Research into pathology ordering and imaging ordering by GPs in Australia demonstrates some areas of excess utilization of these resources.(58,59) Clinical computer users could be expected to be more judicious in their use of pathology and imaging with a resulting lower overall rate of ordering.(43)

### **Total Investigations**

*Results:* In the univariate descriptive comparisons GPs who use a computer for clinical purposes were more likely to order at least one investigation (for 23.1 % of problems, 95% CI: 23.1–24.2) compared with non-clinical computer users (20.4% of problems, 95% CI: 18.7–22.1) (Table 4.14). However, after adjustment in the multivariate analysis this difference was no longer observed ( $p=0.82$ ) (Table 5.1(a)).

*Conclusion:* Clinical computer users order investigations at a higher rate but this difference is explained by characteristics other than the GP's status as a clinical computer user. The hypothesis was therefore rejected.

### **Pathology orders**

*Results:* In the univariate descriptive analysis GPs who use a computer for clinical purposes were more likely to order at least one pathology test (for 17.6 % of problems, 95% CI: 17.1–18.1) compared with non clinical computer users (14.9% of problems, 95% CI: 13.3–16.4) (Table 4.14). However, after adjustment in the multivariate analysis this difference was no longer observed ( $p=0.96$ ) (Table 5.1(a)).

*Conclusion:* GPs using a computer for clinical purposes are more likely to order pathology but this difference was explained by characteristics other than the GPs status as a clinical computer user. The hypothesis was therefore rejected.

### **Imaging orders and other investigations**

*Results:* In the univariate descriptive analysis there was no significant difference in the proportion of problems for which imaging investigations were ordered (Table 4.14) and no difference in the number of imaging tests ordered per 100 encounters (8.6 per 100 for clinical computer users cf. 8.2 for non-computer users) (Table 4.6), nor was any difference observed after adjustment in the multivariate analysis for this indicator (0.35) (Table 5.1(a)). Similar results were observed for other investigations, with no significant differences emerging from either the univariate ( $p=0.5$ ) or multivariate analyses ( $p=0.78$ ) (Table 5.1(a)).

*Conclusion:* There being no differences between the two groups, the hypothesis was rejected.

### **Social disadvantage services**

*Hypothesis:* GPs who use a computer for clinical purposes will have encounters with more patients of Aboriginal and Torres Strait Islander origin, and with more patients who are holders of a Commonwealth Health Care Benefits card, than GPs who do not use a computer for clinical activity.(43)

*Rationale:* Patients of Aboriginal and Torres Strait Islander origin are highly disadvantaged both in terms of health status and access to health care. Similar disadvantage may exist to patients who hold a Commonwealth Health Care Benefits card.(60) The principles of primary health care suggest that good primary care practitioners should endeavour to meet the needs of disadvantaged groups.(43)

#### **Encounters with patients Aboriginal and Torres Strait Islander origin**

*Results:* There was no significant difference between the two GP groups in the proportion of encounters at which the patient identified themselves as an Aboriginal person, or a person of Torres Strait Islander origin (Table 4.7) either in the univariate or multivariate analysis (Table 4.22)

*Conclusion:* There being no differences between the two groups, the hypothesis was rejected.

#### **Encounters with Commonwealth Health Care Benefits card holders**

*Results:* In the univariate descriptive comparisons, the proportion of encounters at which the patient was a Commonwealth Health Care Benefits card holder was significantly smaller with GPs who use a computer for clinical purposes (41.7 per 100 encounters, 95% CI: 40.5–42.9), than the proportion attending their counterparts (47.9 per 100, 95% CI: 44.5–51.2) (Table 4.7). After adjustment in the multivariate analysis this difference remained ( $p=0.035$ ) (Table 4.22).

*Conclusion:* Clinical computer users see fewer patients who are Commonwealth Health Care Benefits card holders, which is the opposite to the hypothesised result. The difference between the two GP groups in the proportion of encounter with Commonwealth Health Care Benefits card holders remained after adjustment for other GP and practice characteristics and is therefore assumed to be directly associated with the GPs status as a clinical computer user. The hypothesis was therefore rejected and reversed.

### **Preventive care**

*Hypothesis:* Clinical computer users will provide higher levels of preventive care than non clinical computer users.

*Rationale:* Prevention of disease is an important public and personal health service provided by GPs, and therefore 'good' GPs will provide higher levels of preventive care to their patients. The RACGP promotes the role of the GP in activities such as screening for cervical cancer and immunization through the 'Red' and 'Green' books.(43)

#### **Rates of Pap Smears at encounters with females aged 15–70 years**

*Results:* In the univariate descriptive analysis, the rate of pap smears per 100 encounters with women aged 15–70 years was slightly higher for GPs who use a computer for clinical purposes (5.7 per 100) than for non clinical computer users (4.1 per 100). However, after adjustment in the multivariate analysis this difference was no longer observed ( $p=0.82$ ) (Table 5.1(a)).

*Conclusion:* Pap smear rates per 100 encounters with women in this age group were higher for GPs who use a computer for clinical activity than for non clinical computer users, however the slightly higher rate was explained by characteristics other than the GPs status as a clinical computer user. The hypothesis was therefore rejected.

#### **Rates of immunisation given at encounters with children aged less than 5 years**

*Results:* In the univariate descriptive analysis, the rate of immunisations per 100 encounters with children aged less than 5 years was significantly higher for GPs who use a computer for clinical purposes (20.5 per 100) than for non clinical computer users (15.2 per 100). However, after adjustment this difference was no longer observed ( $p=0.34$ ) (Table 5.1(a)).

*Conclusion:* Clinical computer users do have a higher immunisation rate per 100 encounters with children aged less than 5 years, but the higher rate was explained by characteristics other than the GPs status as a clinical computer user. As the difference could not be attributed to clinical computer use, the hypothesis was therefore rejected.

#### **Rates of lifestyle counselling provided to patients**

*Hypothesis:* Clinical computer users will provide higher levels of counselling of patients about high-risk life-style behaviours than non clinical computer users.

*Rationale:* The frequency of high-risk behaviours such as smoking, high alcohol intake and poor diet by patients of GPs has been demonstrated in the BEACH reports on GP activity in Australia. The RACGP Guidelines for prevention activities stress the importance of monitoring and intervening in detrimental lifestyle factors. 'High quality' is associated with higher levels of GP counselling of patients regarding high-risk lifestyle behaviours.(43)

*Results:* In the univariate descriptive analysis, the rate for provision of lifestyle counselling was significantly lower for GPs who use a computer for clinical purposes than for non-clinical computer users ( $p=0.03$ ). After adjustment for other GP characteristics, this difference remained ( $p=0.03$ ) (Table 5.1(a)).

*Conclusion:* The relative rates of provision of lifestyle counselling to patients is lower for GPs who use a computer for clinical activity compared with non clinical computer users. As the difference remained after adjustment for GP, practice and patient characteristics, the difference is assumed to be directly associated with the GPs status as a clinical computer user. The hypothesis was therefore rejected and reversed.

## **Inappropriate preventive care**

### ***Rates of Prostate Specific Antigen (PSA) screening tests for males aged over 50 years***

*Hypothesis:* GPs who use a computer for clinical purposes will order fewer prostate specific antigen tests for the screening of prostate cancer in asymptomatic male patients aged over 50 years.(43)

*Rationale:* PSA testing is not recommended as a preventive activity by the RACGP and numerous other authorities.(43) 'High quality' GPs will therefore not use prostate specific antigen for the screening of prostate cancer in asymptomatic patients.(43)

*Results:* There was no significant difference in the relative rate of orders for prostate specific antigen testing for males aged 50 years and over between the two GP groups either before ( $p=0.19$ ) or following adjustment ( $p=0.08$ ) (Table 5.1).

*Conclusion:* As there was no difference between the two groups the hypothesis was rejected.

## **Diabetes**

*Hypothesis:* Clinical computer users will order more HbA1c tests for patients with diabetes and will refer these patients to allied health professionals at a higher rate than non clinical computer users.

*Rationale:* High quality care of patients with diabetes includes monitoring HbA1c levels and appropriate referrals to ophthalmologists, dieticians and podiatrists.(43) National Guidelines for diabetes management highlight the importance of glycaemic control and monitoring neurological and vascular complications of diabetes.(43)

### ***HbA1c orders in the management of diabetes***

*Results:* In the univariate analysis the clinical computer users ordered HbA1c tests for patients with diabetes at a significantly higher rate than their counterparts (25.1 per 100 diabetes contacts cf. 17.6 per 100) ( $p=0.001$ ) Following adjustment in the multivariate analysis, however, this difference was no longer apparent ( $p=0.24$ ) (Table 5.1(a)).

*Conclusion:* Clinical computer users order HbA1c tests per 100 encounters with diabetic patients, at a higher rate than non clinical computer users, but the higher rate is explained by characteristics of the GP or practice other than the GPs status as a clinical computer user. The hypothesis was therefore rejected.

### ***Referral of patients with diabetes to ophthalmologists or allied health***

*Results:* Clinical computer users referred patients with diabetes to ophthalmologists or allied health professionals at a significantly higher rate than GPs not using a computer for clinical activity (7.1 per 100 diabetes contacts cf. 3.6 per 100) ( $p<0.001$ ). Following adjustment for other GP characteristics in the multivariate analysis, this difference remained ( $p=0.002$ ) (Table 5.1(a)).

*Conclusion:* Clinical computer users refer patients with diabetes to ophthalmologists or allied health professionals at a significantly higher rate per 100 encounters with diabetic patients, both before and after adjustment. The hypothesis was therefore accepted.

## **Cardiovascular**

### ***Prescribing of ACE inhibitors in the management of heart failure, ischaemic heart disease, diabetes and cerebrovascular disease***

*Hypothesis:* Clinical computer users will prescribe ACE inhibitors for the management of heart failure, ischaemic heart disease, diabetes and cerebrovascular disease at a higher rate than non-computerised GPs.(43)

*Rationale:* There is increasing evidence that the use of ACE inhibitors will reduce morbidity and mortality in patients with cardiovascular disease and /or diabetes.(43)

*Results:* There was no significant difference in the prescribing rate of ACE inhibitors for these morbidities either in the univariate analysis ( $p=0.07$ ) or following adjustment ( $p=0.86$ ) (Table 5.1(a)).

*Conclusion:* The hypothesis was rejected.

### ***Prescribing/advising of aspirin or clopidogrel in the management of heart failure, ischaemic heart disease, diabetes and cerebrovascular disease***

*Hypothesis:* Clinical computer users will prescribe/advise aspirin or clopidogrel for the management of heart failure, ischaemic heart disease, diabetes and cerebrovascular disease at a higher rate than non clinical computer users.(43)

*Rationale:* There is increasing evidence that aspirin decreases mortality and reinfarction when given to patients with unstable angina, and when given as long-term secondary preventive therapy in a wide range of patients with established cardiovascular disease.(43,61)

*Results:* There was no significant difference in the rate of prescribing or advising for aspirin or clopidogrel for these morbidities either in the univariate analysis ( $p=0.16$ ) or following adjustment for GP and practice characteristics ( $p=0.077$ ) (Table 5.1(a)).

*Conclusion:* The hypothesis was rejected.

### ***Prescribing of warfarin for patients with atrial fibrillation***

*Hypothesis:* Clinical computer users will prescribe warfarin for patients with atrial fibrillation at a higher rate than non clinical computer users.(43)

*Rationale:* Warfarin reduces the risk of stroke in patients with atrial fibrillation and patients over 60 years of age by two thirds.(43)

*Results:* There was no significant difference in the prescribing rate of warfarin for patients with atrial fibrillation aged over 60 years, either in the univariate analysis ( $p=0.42$ ) or following adjustment ( $p=0.42$ ) (Table 5.1(a)).

*Conclusion:* The hypothesis was rejected.

## **Musculoskeletal**

### ***Imaging orders for low back pain or strain / sprain (any site)***

*Hypothesis:* Clinical computer users will order significantly fewer imaging tests for patients with low back pain or strains and sprains of the musculoskeletal system.(43)

*Rationale:* Research into imaging ordering by GPs in Australia demonstrated that imaging orders for low back pain and sprains / strains were in excess of what might be expected if GPs were all complying with US and Australian guidelines. These guidelines are based on evidence that imaging has low productivity in these conditions.(43)

*Results:* There was no significant difference between the GP groups in the rate of imaging orders made for patients with low back pain and sprains/strains of the musculoskeletal system either in the univariate analysis ( $p=0.37$ ) or following adjustment ( $p=0.15$ ) (Table 5.1(a)).

*Conclusion:* The hypothesis was rejected.

### **Prescribing patterns in the management of arthritis**

*Hypothesis 1:* Clinical computer users will prescribe fewer non-steroidal anti-inflammatory agents (NSAIDs) for arthritis in patients aged 65 years and over.(43)

*Hypothesis 2:* Clinical computer users will prescribe more simple and compound analgesics that are not NSAIDs for arthritis in patients aged 65 years and over.(43)

*Rationale:* The adverse effects (such as GI bleeding) of long term NSAID use is well documented in older patients, despite the long term pain control these medications provide. In reducing the prescribing of NSAIDs, clinical computer users may prescribe alternative analgesics more often for these patients.(43)

### **NSAIDS**

*Results:* There was no significant difference between the GP groups in the rate of prescribing of NSAIDs for patients aged 65 years and older with arthritis, either in the univariate analysis ( $p=0.66$ ) or following adjustment ( $p=0.77$ ) (Table 5.1(a)).

*Conclusion:* Hypothesis 1 was rejected.

### **Simple and compound analgesics other than NSAIDs**

*Results:* There was no significant difference between the GP groups in the rate of prescribing of simple and compound analgesics other than NSAIDs for patients aged 65 years and over with arthritis, either in the univariate analysis ( $p=0.41$ ) or following adjustment ( $p=0.38$ ) (Table 5.1).

*Conclusion:* Hypothesis 2 was rejected.

## **Infections**

### **Prescribing of antibiotics for upper respiratory tract infection (URTI)**

*Hypothesis:* Clinical computer users will prescribe antibiotics for URTI less frequently than non clinical computer users.(43)

*Rationale:* The ineffectiveness of antibiotics in URTI, and the risk of antimicrobial resistance promoted by inappropriate prescribing, has been well documented in the literature.(43)

*Results:* There was no significant difference between the GP groups, either before or after adjustment, in the prescribing rates of:

- antibiotics per 100 contacts with URTI (univariate  $p=0.08$ ; multivariate  $p=0.54$ )
- antibiotics per 100 new presentations of URTI (univariate  $p=0.24$ ; multivariate  $p=0.44$ )
- antibiotics per 100 contacts with URTI at encounters with children aged less than five years (univariate  $p=0.42$ ; multivariate  $p=0.92$ ) (Table 5.1(a)).

*Conclusion:* The hypothesis was rejected.

## **Psychological problems**

### ***Depression and insomnia***

*Hypothesis 1:* Clinical computer users will detect and treat more patients with depression, than non clinical computer users.(43)

*Hypothesis 2:* Clinical computer users will provide psychological counselling more often in their management of patients with depression than non clinical computer users.(43)

*Hypothesis 3:* Clinical computer users will prescribe antidepressants less frequently in their management of patients with depression than non clinical computer users.(43)

*Hypothesis 4:* Clinical computer users will prescribe benzodiazepines less frequently for insomnia than non-computerised GPs.(43)

*Rationale:* Reviews of management of depression reported in Clinical Evidence suggest that both antidepressant medication and psychological counselling are effective in mild depression and a combination of the two modalities is more effective in moderate to severe depression.

The use of benzodiazepines in insomnia has caused concern in Australia for some years. The RACGP has introduced educational programs for GPs to reduce benzodiazepine use in insomnia.(43)

### ***Detection of new cases of depression***

*Results:* In the univariate descriptive analysis there was no significant difference between the GP groups in the management rate of new cases of depression ( $p=0.39$ ). Following adjustment however, a difference emerged which was opposite to that hypothesised. Non-clinical computer users detected new cases of depression at a significantly higher rate than clinical computer users ( $p=0.043$ ) (Table 5.1(a)).

*Conclusion:* Non clinical computer users managed new cases of depression at a higher rate than clinical computer users after adjustment for other characteristics of the GP, practice and patients, and this difference is therefore assumed to be directly associated with the GPs status as a clinical computer user. Hypothesis 1 was therefore rejected and reversed.

### ***Psychological counselling***

*Results:* There was no significant difference between the GP groups, either in the univariate descriptive analysis ( $p=0.41$ ) or following adjustment ( $p=0.39$ ), in the rates of psychological counselling provided to patients with depression (Table 5.1(a)).

*Conclusion:* Hypothesis 2 was rejected.

### ***Antidepressants***

*Results:* In the univariate analysis, there was no significant difference between the two GP groups in the rates of prescribing antidepressants to patients with depression ( $p= 0.07$ ). However, following adjustment in the multivariate analysis, clinical computer users prescribed antidepressants for depression at a significantly lower rate (61.3 per 100 contacts with depression) than their counterparts (66.6 per 100 contacts) ( $p=0.02$ ) (Table 5.1(a)).

*Conclusion:* A significant difference was observed between the GP groups in their rates of prescribing of antidepressants for patients with depression, concluded to be entirely associated with the GPs' use of a computer for clinical activity. Hypothesis 3 was accepted.

## **Benzodiazepines**

*Results:* There was no significant difference between the GP groups, either in the univariate analysis ( $p=0.53$ ) or in the multivariate analysis ( $p=0.97$ ) in the prescribing rates of benzodiazepines for insomnia (Table 5.1(a)).

*Conclusion:* Hypothesis 4 was rejected.

## **5.2.2 Quality indicators for GPs with computerised vs non-computerised test ordering**

For the analyses of the 8 quality indicators examined comparing GPs who order tests through their computer compared with those who do not, the results are reported below and presented in Table 5.1(b). Again, the Model used in the multivariate analysis is tabulated beside each indicator, and the characteristics of the GP, practice, patient or morbidity included in each of the Models are listed in the footnotes.

## **Tests and investigations**

*Hypothesis:* GPs who use the test ordering function of their clinical software will order less pathology, less imaging, and fewer investigations overall than GPs who do not use a computer for test ordering.

*Rationale:* The use of the test ordering function in clinical software will encourage GPs to be more judicious in their use of pathology and imaging, therefore reducing their ordering rates for tests and investigations.

### **Total Investigations**

*Results:* In the univariate analysis, GPs who use a computer for test ordering ordered investigations at a higher rate than GPs not using a computer for test ordering ( $p<0.001$ ), which was the reverse of the hypothesised result. However, after adjustment for GP, practice, patient and morbidity characteristics this difference was no longer observed ( $p=0.68$ ) (Table 5.1(b)).

*Conclusion:* Clinical computer users who use the computer to order tests had a significantly higher ordering rate but this difference is explained by characteristics of the GP, practice, patient or morbidity, other than the GPs use of the test ordering function of their clinical software. The hypothesis was therefore rejected.

### **Pathology orders**

*Results:* In the univariate analysis GPs who use a computer for test ordering ordered pathology tests for management of a problem at a significantly higher rate than GPs not using a computer for test ordering ( $p<0.001$ ), which was the reverse of the result hypothesised. However, after adjustment for GP, practice, patient and morbidity characteristics this difference was no longer apparent ( $p=0.41$ ) (Table 5.1(b)).

*Conclusion:* GPs who use a computer to order tests ordered pathology tests at a higher rate but this difference is explained by characteristics of the GP, practice, patient or morbidity, other than the GP's use of a computer to order tests. The hypothesis was therefore rejected.

### **Imaging orders**

*Results:* In the univariate analysis there was no significant difference in the rate of imaging tests ordered per 100 encounters between GPs who order tests via their computer and those who do not ( $p=0.64$ ), nor was any difference observed in this indicator after adjustment for GP, practice, patient and morbidity characteristics ( $p=0.34$ ) (Table 5.1(b)).

*Conclusion:* There being no differences between the two groups, the hypothesis was rejected.

### **Other investigations**

*Results:* In the univariate analysis GPs who use a computer for test ordering were more likely to order at least one test labelled as ‘other’ investigations for management of a problem (1.1 per 100 encounters) than GPs not using a computer for test ordering (1.0 per 100 encounters) ( $p=0.046$ ), which was the reverse of the result hypothesised. However, after adjustment for GP, practice, patient and morbidity characteristics this difference was no longer apparent ( $p=0.69$ ) (Table 5.1(b)).

*Conclusion:* GPs who use a computer to order tests are more likely to order other investigations (the reverse of the hypothesis) but this difference is explained by characteristics of the GP, practice, patient or morbidity, other than the GPs use of a computer to order tests. The hypothesis was therefore rejected.

### **Preventive care**

*Hypothesis:* GPs who use the test ordering function of their clinical software will provide higher levels of preventive care than GPs who do not use a computer for test ordering.

*Rationale:* Prevention of disease is an important public and personal health service provided by GPs, and therefore ‘good’ GPs will provide higher levels of service.(43)

#### **Rates of Pap Smears at encounters with females aged 15–70 years**

*Results:* In the univariate analysis, the rate of pap smears per 100 encounters with women aged 15–70 years was slightly higher for GPs who use a computer for test ordering (5.9 per 100) than for GPs who do not order tests through their clinical software (4.3 per 100) ( $p=0.006$ ). However, after adjustment for GP and practice characteristics and patient age (Model 5A plus patient age, because of the age range most likely to be sexually active) this difference was no longer observed ( $p=0.85$ ) (Table 5.1(b)).

*Conclusion:* Pap smear rates per 100 encounters with women aged 15–70 years were higher for GPs who order tests through a computer than for GPs who do not, however the slightly higher rate was explained by variables other than the GPs use of a computer to order tests. The hypothesis was therefore rejected.

### **Inappropriate preventive care**

#### **Rates of Prostate Specific Antigen (PSA) screening tests for males aged over 50 years**

*Hypothesis:* GPs who use the test ordering function of their clinical software will order fewer prostate specific antigen tests for the screening of prostate cancer in asymptomatic male patients aged over 50 years.(43)

*Rationale:* PSA testing is not recommended as a preventive activity by the RACGP and numerous other authorities. ‘High quality’ GPs will therefore not use prostate specific antigen for the screening of prostate cancer in asymptomatic patients.(43)

*Results:* There was no significant difference in the rate of orders for PSA testing for males aged 50 years and over between the two GP groups either before ( $p=0.34$ ) or following adjustment for GP and practice characteristics ( $p=0.27$ ) (Table 5.1(b)).

*Conclusion:* As there was no difference between the two groups the hypothesis was rejected.

## **Diabetes**

*Hypothesis:* GPs who order tests through their computer will order more HbA1c tests for patients with diabetes than GPs who do not order tests through their computer.

*Rationale:* High quality care of patients with diabetes includes monitoring HbA1c levels. National Guidelines for diabetes management highlight the importance of glycaemic control.(43)

### **HbA1c orders in the management of diabetes**

*Results:* In the univariate analysis GPs who ordered tests through their computers ordered HbA1c tests for patients being managed for diabetes at a significantly higher rate than their non-computerised counterparts (26.3 per 100 diabetes contacts cf. 18.6 per 100) ( $p<0.001$ ). Following adjustment for GP and practice characteristics, this difference remained ( $p=0.015$ ).

*Conclusion:* GPs who order tests through their computer ordered HbA1c tests per 100 contacts with patients with diabetes, at a higher rate than GPs who did not order tests through their computer, and this difference can therefore be attributed to the GPs use of clinical software for test ordering or for a GP or practice variable(s) not measured in this study (Table 5.1(b)). The hypothesis was accepted.

## **Musculoskeletal**

### **Imaging orders for low back pain or strain/sprain (any site)**

*Hypothesis:* GPs who order tests through their computer will order significantly fewer imaging tests for patients with low back pain or strains and sprains of the musculoskeletal system.(43)

*Rationale:* Research into imaging ordering by GPs in Australia demonstrated that imaging orders for low back pain and sprains/strains were excessive compared with that expected if GPs were working in compliance with US and Australian guidelines. The guidelines are based on evidence that imaging had low productivity in these conditions.(43)

*Results:* There was no significant difference between the GP groups in the rate of imaging orders made for patients with low back pain and sprains/strains of the musculoskeletal system either in the univariate analysis ( $p=0.64$ ) or following adjustment for GP and practice characteristics ( $p=0.34$ ) (Table 5.1(b)).

*Conclusion:* The hypothesis was rejected.

**Table 5.1(a): Univariate and multivariate analysis of quality indicators (using linear regression) (ordinal and continuous variables)**

Quality indicator	GPs using a computer for clinical purposes		GPs not using a computer for clinical purposes		Unadjusted		Adjusted <sup>(a)</sup>		
	Denominator (n)	Mean	Denominator (n)	Mean	Regression coefficient	p value	Model used	Regression coefficient	p value
Consultation length (in minutes)	34,633	15.0	6,084	15.0	0.05	0.90	C	-0.38	0.40
	Denominator (n)	Rate per 100 of (n)	Denominator (n)	Rate per 100 of (n)	Regression coefficient	p value	Model used <sup>(b)</sup>	Regression coefficient	p value
Long consultations per 100 encounters	99,153	12.2	17,478	10.7	1.50	0.14	C	-0.41	0.70
Prolonged consultations per 100 encounters	99,153	1.0	17,478	1.1	1.37	0.24	C	-0.37	0.76
Reasons for encounter per 100 encounters	106,900	150.7	18,800	150.1	0.54	0.81	B	0.59	0.82
Problems managed per 100 encounters	106,900	150.5	18,800	144.1	6.42	0.003	B	3.44	0.12
Clinical treatments per 100 encounters	106,900	39.7	18,800	40.1	-0.40	0.88	C	-2.72	0.32
Procedural treatments per 100 encounters	106,900	17.6	18,800	18.4	-0.82	0.57	C	-1.26	0.31
Prescribed medications per 100 encounters	106,900	81.9	18,800	89.8	-7.96	0.01	C	-6.54	0.02
Allied health referrals per 100 encounters	106,900	3.0	18,800	2.7	0.28	0.29	C	-0.55	0.03
Hospital referrals per 100 encounters	106,900	0.6	18,800	0.7	-0.17	0.23	C	-0.14	0.47
Specialist referrals per 100 encounters	106,900	8.3	18,800	7.5	0.83	0.06	C	-0.01	0.98
Total investigations per 100 encounters	106,900	51.3	18,800	41.7	9.6	<0.001	C	-0.60	0.82
Pathology test orders per 100 encounters	106,900	41.6	18,800	32.6	8.96	<0.001	C	-0.11	0.96

(continued)

**Table 5.1(a) (continued): Univariate and multivariate analysis of quality indicators (using linear regression) (ordinal and continuous variables)**

Quality indicator	GPs using computer for clinical purpose		GPs not using computer for clinical purpose		Unadjusted		Adjusted <sup>(a)</sup>		
	Denominator (n)	Rate per 100 of (n)	Denominator (n)	Rate per 100 of (n)	Regression coefficient	p value	Model used	Regression coefficient	p value
Imaging test orders per 100 encounters	106,900	8.6	18,800	8.2	0.44	0.38	C	-0.53	0.35
Other investigations per 100 encounters	106,900	1.1	18,800	0.9	0.22	0.05	C	0.04	0.78
Pap smear per 100 encounters with females aged 15-70 yrs	43,090	5.7	7,095	4.1	1.58	0.045	A + patient age	-0.16	0.82
All immunisation per 100 encounters with patients < 5 years old	6,740	20.5	868	15.2	5.24	0.036	A	3.50	0.34
Lifestyle counselling per 100 encounters	106,900	7.2	18,800	8.9	-1.70	0.03	B	-1.72	0.03
PSA tests per 100 screening contacts with males > 50 years old	1,674	9.8	214	13.1	-3.29	0.19	A	-4.85	0.08
HbA1c per 100 contacts with diabetes	3,432	25.1	688	17.6	7.53	0.001	A	3.10	0.24
Referrals to ophthalmologist or allied health per 100 contacts with diabetes	3,432	7.1	688	3.6	3.50	<0.001	A	2.94	0.002
ACE inhibitors per 100 contacts with LVF, IHD, diabetes or cerebrovascular disease	5,838	5.9	1,075	4.5	1.48	0.07	A	0.16	0.86
Aspirin or clopidogrel per 100 contacts with LVF, IHD, diabetes or cerebrovascular disease	5,838	8.7	1,075	9.6	-0.90	0.46	A	-1.93	0.14
Warfarin per 100 contacts with atrial fibrillation	906	35.4	145	40.0	-4.57	0.42	A	-5.23	0.42

(continued)

**Table 5.1(a) (continued): Univariate and multivariate analysis of quality indicators (using linear regression)**

Quality indicator	GPs using computer for clinical purpose		GPs not using computer for clinical purpose		Unadjusted		Adjusted <sup>(a)</sup>		
	Denominator (n)	Rate per 100 of (n)	Denominator (n)	Rate per 100 of (n)	Regression coefficient	p value	Model used	Regression coefficient	p value
Imaging per 100 contacts with lower back pain or strain/sprain	5,036	14.8	917	16.3	-1.48	0.37	A	-2.73	0.15
NSAIDs per 100 contacts with arthritis (all types) and >65	2,347	38.0	394	39.6	-1.59	0.66	A	-1.18	0.77
Analgesics (non NSAID) per 100 contacts with arthritis and >65	2,347	27.2	394	29.7	-2.51	0.41	A	-3.51	0.38
Antibiotics prescriptions per 100 contacts with URTI	5,072	34.7	912	41.2	-6.49	0.08	A	2.66	0.54
Antibiotics prescriptions per 100 contacts with new URTI	3,841	36.9	714	41.7	-4.82	0.24	A	3.65	0.44
Antibiotics prescriptions per 100 contacts with URTI in children aged <5	1,122	20.4	154	24.7	-4.27	0.42	A	0.60	0.92
New diagnosis of depression per 100 encounters	106,900	0.7	18,800	0.8	-0.07	0.39	B	-0.21	0.043
Counselling per 100 contacts with depression	4,342	13.5	716	12.0	1.53	0.41	A	1.87	0.39
Antidepressants per 100 contacts with depression	4,342	61.3	716	66.6	-5.31	0.07	A	-7.57	0.02
Benzodiazepine per 100 contacts with insomnia	1,719	57.6	284	60.6	-2.97	0.53	A	-0.16	0.97

(a) Adjusted using one of the following models:

Model A - controlling for GP age; GP sex; FRACGP status; work in deputising service in preceding 4 weeks; bulk-billing for all patients; practice accreditation status; presence of a practice nurse at the major practice address.

Model B - controlling for patient age; patient sex; Commonwealth Health Care Benefits Cardholder status; Veterans' Affairs card holder status; NESB status; Aboriginal or Torres Strait Islander status; 'new patient' status; GP and practice characteristics included in Model A.

Model C - controlling for the presence or absence of problems managed by ICPC-2 Chapter at the encounter; the GP, practice and patient characteristics included in Model B.

Note: Shading = statistically significant difference; PSA = Prostate Specific Antigen; LVF = left ventricular failure; IHD = Ischaemic heart disease; HbA1c = Haemoglobin, type A1c; ACE = angiotensin converting enzyme; URTI = upper respiratory tract infection; NSAID = non-steroidal anti-inflammatory drug.

**Table 5.1(b): Univariate and multivariate analysis of quality indicators (using linear regression) (ordinal and continuous variables)**

Quality indicator	GPs using a computer for test ordering		GPs not a using computer for test ordering		Unadjusted <sup>(a)</sup>		Adjusted <sup>(b)</sup>		
	Denominator (n)	Rate per 100 of (n)	Denominator (n)	Rate per 100 of (n)	Regression coefficient <sup>(a)</sup>	p value	Model used <sup>(b)</sup>	Regression coefficient <sup>(b)</sup>	p value
Pathology test orders per 100 encounters	90,100	42.6	35,600	34.3	8.25	<0.001	C	1.28	0.41
Imaging test orders per 100 encounters	90,100	8.6	35,600	8.4	0.19	0.62	C	-0.59	0.15
Other investigations per 100 encounters	90,100	1.1	35,600	1.0	0.18	0.046	C	0.04	0.69
Total investigations per 100 encounters	90,100	52.3	35,600	43.7	8.62	<0.001	C	0.73	0.68
Pap smear per 100 encounters with females aged 15-70 yrs	36,751	5.9	13,434	4.3	1.57	0.006	A + patient age	-0.09	0.85
PSA tests per 100 screening contacts with males > 50 years old	1,408	9.7	480	11.5	-1.73	0.34	A	-2.22	0.27
HbA1c per 100 contacts with diabetes	2,838	26.3	1,282	18.6	7.69	<0.001	A	4.72	0.015
Imaging per 100 contacts with lower back pain or strain/sprain	4,182	14.8	1,771	15.4	-0.59	0.64	A	-1.32	0.34

(a): Missing data removed.

(b): Adjusted using one of the following models:

Model A - controlling for GP age; GP sex; FRACGP status; work in deputising service in preceding 4 weeks; bulk-billing for all patients; practice accreditation status; presence of a practice nurse at the major practice address.

Model B - controlling for patient age; patient sex; Commonwealth Health Care Benefits Cardholder status; Veterans' Affairs card holder status; NESB status; Aboriginal or Torres Strait Islander status; 'new patient' status; GP and practice characteristics included in Model A.

Model C - controlling for the presence or absence of problems managed by ICPC-2 Chapter at the encounter; the GP, practice and patient characteristics included in Model B.

Note: Shading = statistically significant difference.

### 5.2.3 Overview of results for quality indicators

Table 5.2(a) provides a summary of all the quality indicators examined in this study, either in earlier sections or in the current chapter. It shows the indicators that did not discriminate at either univariate descriptive or multivariate levels of analysis, or both (marked with a single X). For other indicators, the use of a tick (✓) shows where differentiation occurred between clinical computer users and GPs who did not use a computer in their clinical activity, by showing that the indicator discriminated and the hypothesis was accepted in either the unadjusted results, after statistical adjustments were made, or both. For some indicators, the hypothesis was accepted at the univariate level (as indicated with a tick (✓), but ultimately rejected following adjustment (marked with a single X). Where the hypothesis was rejected, and the outcome was a reversal of the hypothesis, the result is marked with XX.

From the 36 quality indicators tested, a significant difference was detected between the two groups for only seven indicators. These are reported below.

#### Consultation patterns

Of the quality indicators associated with **consultation patterns**, the only difference to emerge was in the number of problems managed at the encounter. GPs who use a computer for clinical activity manage more problems per encounter than their non-computerised counterparts. However, the higher number of problems managed per encounter was explained by characteristics other than their use of a computer.

#### Pharmacological management

In **pharmacological management**, the quality indicator demonstrated that (as hypothesised) clinical computer users overall prescribe significantly fewer medications than non clinical computer users.

#### Referrals

The quality indicators measuring **referrals** showed no differences between the two groups in regard to referrals to hospitals or to specialists at any level of analysis. However, the rate of referral to allied health professionals was significantly lower for clinical computer users after adjustment, although the difference was small and not apparent in the descriptive analysis.

#### Appropriate preventive care

In the domain of **appropriate preventive care** clinical computer users performed ‘better’ than their counterparts for both the rate of pap smears for women of 15–70 years, and in the rate of immunisations with patients aged less than 5 years. However, in both cases, the differences were explained by characteristics other than computer use for clinical activity.

#### Management of diabetes

In the **management of diabetes**, clinical computer users ordered significantly more HbA1c tests for patients with diabetes, but the difference was associated with characteristics other than their use of a computer. As hypothesised, clinical computer users referred patients with diabetes to ophthalmologists and other allied health professional at a higher rate than non clinical computer users, and this was due to computer use.

#### Management of psychological problems

In the **management of psychological problems**, clinical computer users prescribed antidepressants to patients with depression at a lower rate than computerised GPs, but the difference was small and not discernable in the descriptive analysis. The hypothesis that

clinical computer users would detect, and therefore manage, more depression was rejected and reversed. The management rate of depression did not differ between the two groups at either level of analysis. The detection rate of 'new' cases of depression did not differ between the groups in the univariate comparison, but following adjustment, it emerged that clinical computer users detected fewer new cases of depression than non-clinical computer users, which was a reversal of the hypothesis. There were no other differences between the two GP groups for the other quality indicators measured in this domain.

### **Quality indicators for GPs with computerised vs non-computerised test ordering**

Table 5.2(b) provides a similar overview for those indicators compared between the GPs who specifically used the test ordering function of their computer, to determine whether the use of this specific function elicits a different result to the use of a computer itself as a clinical tool.

The results of the eight additional analyses to investigate any differences specifically associated with test ordering through the computer (as opposed to using the computer as a clinical tool in practice activity) produced only one significant difference that remained after adjustment for other variables in the modelling process.

At the univariate level, GPs who ordered tests through their computer had significantly higher ordering rates for pathology tests, total tests, other investigations, and pap smears for females aged 15–20 years. After adjustment for other GP, practice, patient and morbidity characteristics these differences were no longer observable, and must therefore be associated with factors other than the GP's use of the computer for test ordering. There were no differences at either level of analysis in the ordering rate for imaging tests, PSA tests per 100 contacts with males aged 50 years or older, or for imaging for patients with lower back pain or strain/sprain.

### **Management of diabetes**

In the management of diabetes, GPs who ordered tests through their computer ordered significantly more HbA1c tests for patients with diabetes, and this difference remained after adjustment for other GP and practice characteristics. There is a real association between use of clinical software for ordering these tests and an increase in the rate of tests ordered.

**Table 5.2(a): Summary of results for all quality indicators**

<b>Domain</b>	<b>Quality indicator</b>	<b>Descriptive analysis</b>	<b>After adjustment</b>
Consultation patterns	Proportion of long consultations (hypothesis = computerised GPs more)	<b>X</b>	<b>X</b>
	Proportion of prolonged consultations (hypothesis = computerised GPs more)	<b>X</b>	<b>X</b>
	Length of consultation (minutes and seconds) hypothesis = computerised GPs longer)	<b>X</b>	<b>X</b>
	Number of patient reasons for encounter (hypothesis = computerised GPs more)	<b>X</b>	<b>X</b>
	Number of problems managed at encounter (hypothesis = computerised GPs more)	✓	<b>X</b>
	Non-pharmacological management	Clinical treatment rate (hypothesis = computerised GPs more)	<b>X</b>
Procedural treatment rate (hypothesis = computerised GPs more)		<b>X</b>	<b>X</b>
Pharmacological management	Overall prescribing rate (hypothesis = computerised GPs lower)	✓	✓
Referrals	Referrals to allied health professionals (hypothesis = computerised GPs more)	<b>X</b>	<b>X X</b>
	Referrals to hospitals (hypothesis = computerised GPs less)	<b>X</b>	<b>X</b>
	Referrals to specialists (hypothesis = computerised GPs less)	<b>X</b>	<b>X</b>
Tests and investigations	Investigations (total) (hypothesis = computerised GPs less)	<b>X X</b>	<b>X</b>
	Pathology test order rate (hypothesis = computerised GPs less)	<b>X X</b>	<b>X</b>
	Imaging test order rate (hypothesis = computerised GPs less)	<b>X</b>	<b>X</b>
	Other investigation order rate (hypothesis = computerised GPs less)	<b>X</b>	<b>X</b>
Social disadvantage services	Encounters with Aboriginal or Torres Strait Islander people (hypothesis = computerised GPs more)	<b>X</b>	<b>X</b>
	Encounters with patients holding a Commonwealth Health Care Benefits card (hypothesis = computerised GPs more)	<b>X X</b>	<b>X X</b>
Appropriate preventive care	Pap smears per 100 encounters with females ages 15-75 years (hypothesis = computerised GPs more)	✓	<b>X</b>
	All immunisations per 100 encounters with patients aged <5 years (hypothesis = computerised GPs more)	✓	<b>X</b>
	Lifestyle counselling per 100 encounters (hypothesis = computerised GPs more)	<b>X X</b>	<b>X X</b>

(continued)

**Table 5.2(a) (continued): Summary of results for all quality indicators**

<b>Domain</b>	<b>Quality indicator</b>	<b>Descriptive analysis</b>	<b>After adjustment</b>
Inappropriate preventive care	PSA tests/100 screening encounters with males aged 50+ years ( <i>hypothesis = computerised GPs less</i> )	X	X
Diabetes management	HbA1cs ordered per 100 contacts with patients with diabetes ( <i>hypothesis = computerised GPs more</i> )	✓	X
	Referrals to ophthalmologists per 100 contacts with patients with diabetes ( <i>hypothesis = computerised GPs more</i> )	✓	✓
Cardiovascular disease management	ACE inhibitors per 100 encounters with patients with heart failure, ischaemic heart disease, diabetes or cerebrovascular disease ( <i>hypothesis = computerised GPs more</i> )	X	X
	Aspirin or clopidogrel per 100 encounters with patients with heart failure, ischaemic heart disease, diabetes or cerebrovascular disease ( <i>hypothesis = computerised GPs more</i> )	X	X
	Warfarin per 100 contacts with patients with atrial fibrillation ( <i>hypothesis = computerised GPs more</i> )	X	X
Musculoskeletal disease management	Imaging orders per 100 patients with low back pain or strain/sprain (any site) ( <i>hypothesis = computerised GPs less</i> )	X	X
	Prescribing of non-steroidal anti-inflammatory agents in the management of arthritis for patients 65+ years ( <i>hypothesis = computerised GPs less</i> )	X	X
	Prescribing of simple analgesics for the management of arthritis for patients 65+ years ( <i>hypothesis = computerised GPs more</i> )	X	X
Infection management	Antibiotics for upper respiratory tract infection (total) ( <i>hypothesis = computerised GPs less</i> )	X	X
	Antibiotics for new presentations of upper respiratory tract infection ( <i>hypothesis = computerised GPs less</i> )	X	X
	Antibiotics for upper respiratory tract infection in patients <5 years ( <i>hypothesis = computerised GPs less</i> )	X	X
Psychological problem management	Detection of depressed patients ( <i>hypothesis = computerised GPs more frequent management</i> )	X	X X
	Rates of counselling in management of depression <i>hypothesis = computerised GPs more</i> )	X	X
	Prescription rate of anti-depressants for depression <i>hypothesis = computerised GPs less</i> )	X	✓

(continued)

**Table 5.2(a) (continued): Summary of results for all quality indicators**

Domain	Quality indicator	Descriptive analysis	After adjustment
Tests and investigations	Pathology test order rate ( <i>hypothesis = computerised GPs less</i> )	<b>X X</b>	<b>X</b>
	Imaging test order rate ( <i>hypothesis = computerised GPs less</i> )	<b>X</b>	<b>X</b>
	Other investigations order rate ( <i>hypothesis = computerised GPs less</i> )	<b>X X</b>	<b>X</b>
	Investigations (total) order rate ( <i>hypothesis = computerised GPs less</i> )	<b>X X</b>	<b>X</b>
Appropriate preventive care	Pap smears per 100 encounters with females ages 15-75 years ( <i>hypothesis = computerised GPs more</i> )	✓	<b>X</b>
Inappropriate preventive care	PSA tests/100 screening encounters with males aged 50+ years ( <i>hypothesis = computerised GPs less</i> )	<b>X</b>	<b>X</b>
Diabetes management	HbA1cs ordered per 100 contacts with patients with diabetes ( <i>hypothesis = computerised GPs more</i> )	✓	✓
Musculoskeletal disease management	Imaging orders per 100 patients with low back pain or strain/sprain (any site) ( <i>hypothesis = computerised GPs less</i> )	<b>X</b>	<b>X</b>

Note: ✓ – Hypothesis accepted; **X** – Hypothesis rejected, there being no significant differences between the groups; **XX** – Hypothesis rejected, result reversed from that hypothesised.

## 5.2.4 Summary of results for quality indicators

The results are presented more concisely in Table 5.3, with the indicators being grouped according to whether the hypotheses were proven or not.

- Table 5.3(a): Indicators in which clinical computer users differ from non clinical computer users in reality and their use of a computer for clinical activity remains the only explanation (of the characteristics examined in this study) for the difference in behaviour between the two groups.
- Table 5.3(b): Indicators in which clinical computer users perform ‘better’ than non computer users, but the difference is explained by characteristics of this group other than their use of a computer for clinical activity.
- Table 5.3(c): Indicators which showed no significant difference between the two GP groups in either the descriptive analysis or following adjustment for other characteristics.
- Table 5.3(d): Indicators in which clinical computer users demonstrated in either the univariate and / or multivariate analyses the reverse behaviour to that hypothesised.

**Table 5.3(a): Indicators for which clinical computer use remains the only explanation (from measured factors) for differences**

Quality indicator	Descriptive analysis	After adjustment
Overall prescribing rate (hypothesis = computerised GPs lower)	✓	✓
Referrals to ophthalmologists per 100 contacts with patients with diabetes (hypothesis = computerised GPs more)	✓	✓
Prescription rate of anti-depressants for depression (hypothesis = computerised GPs less)	X	✓
<b>Computer vs non-computer - test ordering</b>		
HbA1cs ordered per 100 contacts with patients with diabetes (hypothesis = computerised GPs more)	✓	✓

Note: ✓ – Hypothesis accepted; X – Hypothesis rejected, there being no significant differences between the groups.

**Table 5.3(b): Indicators for which clinical computer users perform 'better' but the difference is due to other measured factors rather than their status as clinical computer users**

Quality indicator	Descriptive analysis	After adjustment
Number of problems managed at encounter (hypothesis = computerised GPs more)	✓	X
Pap smears per 100 encounters with females ages 15-75 years (hypothesis = computerised GPs more)	✓	X
All immunisations per 100 encounters with patients aged <5 years (hypothesis = computerised GPs more)	✓	X
HbA1cs ordered per 100 contacts with patients with diabetes (hypothesis = computerised GPs more)	✓	X
<b>Computer vs non-computer - test ordering</b>		
Pap smears per 100 encounters with females ages 15-75 years (hypothesis = computerised GPs more)	✓	X

Note: ✓ – Hypothesis accepted; X – Hypothesis rejected, there being no significant differences between the groups

**Table 5.3(c): Indicators which showed no significant difference between clinical computer users and non-clinical computer users both in descriptive analyses and after adjustment for other factors**

Quality indicator	Descriptive analysis	After adjustment
Proportion of long consultations (hypothesis = computerised GPs more)	X	X
Proportion of long + prolonged consultations (hypothesis = computerised GPs more)	X	X
Length of consultation (minutes and seconds) (hypothesis = computerised GPs longer)	X	X
Number of patient reasons for encounter (hypothesis = computerised GPs more)	X	X
Clinical treatment rate (hypothesis = computerised GPs more)	X	X
Procedural treatment rate (hypothesis = computerised GPs more)	X	X
Referrals to hospitals (hypothesis = computerised GPs less)	X	X
Referrals to specialists (hypothesis = computerised GPs less)	X	X
Imaging test order rate (hypothesis = computerised GPs less)	X	X
Other investigations order rate (hypothesis = computerised GPs less)	X	X
Encounters with Aboriginal or Torres Strait Islander people (hypothesis = computerised GPs more)	X	X
PSA tests/100 screening encounters with males aged 50+ years (hypothesis = computerised GPs less)	X	X
ACE inhibitors per 100 encounters with patients with heart failure, ischaemic heart disease, diabetes or cerebrovascular disease (hypothesis = computerised GPs more)	X	X
Aspirin or clopidogrel per 100 encounters with patients with heart failure, ischaemic heart disease, diabetes or cerebrovascular disease (hypothesis = computerised GPs more)	X	X
Warfarin per 100 contacts with patients with atrial fibrillation (hypothesis = computerised GPs more)	X	X
Imaging orders per 100 patients with low back pain or strain/sprain (any site) (hypothesis = computerised GPs less)	X	X
Prescribing of non-steroidal anti-inflammatory agents in the management of arthritis for patients 65+ years (hypothesis = computerised GPs less)	X	X
Prescribing of simple analgesics for the management of arthritis for patients 65+ years (hypothesis = computerised GPs less)	X	X
Antibiotics for upper respiratory tract infection (total) (hypothesis = computerised GPs less)	X	X

(continued)

**Table 5.3(c)(continued): Indicators which showed no significant difference between clinical computer users and non-clinical computer users both in descriptive analyses and after adjustment for other factors**

Quality indicator	Descriptive analysis	After adjustment
Antibiotics for new presentations of upper respiratory tract infection (hypothesis = computerised GPs less)	X	X
Antibiotics for upper respiratory tract infection in patients <5 years (hypothesis = computerised GPs less)	X	X
Rates of counselling in management of depression (hypothesis = computerised GPs more)	X	X
Prescription of benzodiazepines for insomnia (hypothesis = computerised GPs less)	X	X
<b>Computer vs non-computer - test ordering</b>		
Pathology test order rate (hypothesis = computerised GPs less)	X	X
Other investigations order rate (hypothesis = computerised GPs less)	X	X
Investigations (total) order rate (hypothesis = computerised GPs less)	X	X

Note: X – Hypothesis rejected, there being no significant differences between the groups.

**Table 6.3(d): Indicators for which clinical computer users demonstrated the reverse behaviour to that hypothesised in the univariate and/or multivariate analyses**

Quality indicator	Descriptive analysis	After adjustment
Referrals to allied health professionals (hypothesis = computerised GPs more)	X	X X
Investigations (total) (hypothesis = computerised GPs less)	X X	X
Pathology test order rate (hypothesis = computerised GPs less)	X X	X
Encounters with patients holding a Commonwealth Health Care Benefits card (hypothesis = computerised GPs more)	X X	X X
Detection of depressed patients (hypothesis = computerised GPs more)	X	X X
Lifestyle counselling per 100 encounters (hypothesis = computerised GPs more)	X X	X X
<b>Computer vs non-computer - test ordering</b>		
Pathology test order rate (hypothesis = computerised GPs less)	X X	X
Other investigations order rate (hypothesis = computerised GPs less)	X X	X
Investigations (total) order rate (hypothesis = computerised GPs less)	X X	X

Note: X – Hypothesis rejected, there being no significant differences between the groups; XX – Hypothesis rejected, result reversed from that hypothesized

## 6 Embedded advertising in clinical software

Over recent decades a number of factors have been shown to influence the prescribing behaviour of general practitioners (GP). These factors include guideline reminders & educational interventions,(62-64) scientific journal articles,(65) detailing visits from pharmaceutical company representatives which may include promotional materials and product samples,(66-68) attitudes of peers and ‘opinion leaders’ or authority figures,(69,70) prescribing behaviour of specialists or hospital physicians,(71,72) patient expectation,(73-75) advertising in medical journals and periodicals,(72,76-78) and industry sponsored education and gifts ranging from meals to conference travel to research funding.(66,79,80) While a great deal of literature describes the effects of advertising and other methods of promotion,(81-83) doctors generally feel that they are immune to the effects of these influences.(65,66,69,82)

Interested stakeholders are keen to know what ‘works best’ in order to either use that method of promotion, or to curtail it where possible, depending on their perspective. These include general practice educational bodies advocating best practice; those promoting Quality Use of Medicines (QUM); government groups interested in judicious prescribing both for QUM and for reasons of economy; and the pharmaceutical industry looking to recoup the vast capital outlay invested in developing and producing the medications doctors prescribe and to make a profit for their shareholders.

In the early 1990s the first (and currently only) clinical software system with embedded advertising (referred to hereafter as ‘advertising software’) was released to medical practitioners in Australia. The vendors employed an advertising revenue strategy to offset the cost of the product and sent a full working copy out to all GPs.(84,85) At the time this study commenced (November 2003) the types of advertisements embedded in the software included full screen images and strip messages, with or without animation. The ‘pop-up’ full-screen advertisements appeared when any document was printed (this function has since been removed). The strip messages cycled through the program’s screens during the course of each work session, at the opening of each patient record, when new data were added to a record, or when prescriptions or pathology orders were prepared. The strip advertisements were also displayed when the software’s clinical support tools were accessed. The software developers provided quarterly updates, and advertisements could change with each new version. The advertisements cycled for a month within each version, allowing for three different sets of advertisements to be shown within the quarter. An advertisement could be repeated in all three sets, and in multiple cycles.

When this study commenced, promotional information from the software developers quoted the price of primary full screen advertisements was \$7,380 for one month (\$19,557 for 3 months) and the minor strip advertisements at \$4,768 for one month (\$12,675 for three months).(86) While the majority of advertisements were for pharmaceutical products, advertising ‘space’ had also been purchased by medical indemnity insurers, private health insurers, pathology providers, divisions of general practice, employment networks, the Australian Government Department of Health and Ageing (DoHA), and other non-profit organisations such as the National Heart Foundation, the National Prescribing Service, and Medicines San Frontières.

In 2005, Harvey et al(87) reviewed the advertising software and reported that 95% of pharmaceutical advertisements appeared to be noncompliant with the Medicines Australia Code of Conduct(88) through one or more of the following: missing information; illegibility of generic names; claims that were unsubstantiated; lack of PBS listing information, or were in breach of the Therapeutic Goods Act 1989(89) regarding direct to consumer advertising of pharmaceutical products. Given the monetary cost of these advertisements, and the controversy regarding their potential to influence GPs to prescribe specific brands of medications over other, equally

efficacious ones, the aim of this Chapter is to examine the effect of advertisements embedded in clinical software on the prescribing behaviour of the GPs who use it.

## **6.1 Methods**

The methods utilised for this chapter are based on the BEACH methodology described in Chapter 2. As described in Chapter 3, the additional questions designed for the GP Profile questionnaire were used to investigate the clinical computer use of individual BEACH GPs.

The foci for this study were the profile questions related to the GPs' individual computer use, and to the question asked to determine what prescribing / medical record software they used. For this analysis, prescriptions recorded by the GP, and the clinical software program they use were the elements investigated.

### **6.1.1 The participants**

Of the 1,336 GPs included in this investigation, 79 did not provide responses about their use of computers and a further 35 did not report which software they used. These were removed from the analyses. The remaining 1,222 GPs had reported the brand of software they use and these were included in this section of the analysis.

The GPs who had reported using the brand of software containing pharmaceutical advertising and who indicated that they use the clinical functions of their software program were included into the 'exposed' group on the basis that they would be exposed to advertisements through their software. There were 773 GPs in this group. GPs who did not use advertisement embedded software, did not use the computer for clinical activity, or who did not use a computer at all, were included in the second, 'non-exposed' group. The second group also included 20 GPs who reported having the advertising embedded software available at their practice, but 15 of these did not use a computer at all, 4 used their computer for internet access only, and 1 for internet and email only. These were included in the non-exposure group on the basis that they would not have been exposed to the advertising. There were 484 GPs in the 'non-exposed' group.

### **Definitions**

*The exposed group* was defined as the users of Medical Director<sup>®</sup> software (the advertising software) for clinical functions as previously defined in earlier Chapters i.e. prescribing and/or test ordering and/or medical records<sup>†</sup>, with or without internet and/or email.

*The non-exposed group* was defined as the GPs who used other software, did not use a computer for clinical purposes, or did not use a computer at all (i.e. those not exposed to advertising through software).

### **6.1.2 Pharmaceutical product advertisements**

Specific recording dates for the patient encounter data were available for each GP in BEACH, and therefore could reasonably be matched to the dates advertisements were shown in the software. However, we could not ascertain which version of the software was being used by GPs who recorded around the time of the release of software updates. Consequently, we could not be certain which advertisements they were exposed to in their software during their BEACH recording time. For this reason we chose to investigate the prescribing for those products that were shown continuously throughout the study period in every version of the software.

There were seven products shown continuously i.e. in the cycle of advertisements through every month of each quarterly updated version of the advertising embedded software. These products were:

- Lipitor (atorvastatin – a HMC CoA reductase inhibitor)
- Micardis (telmisartan – an angiotensin II receptor antagonist)
- Mobic (meloxicam – a non-steroidal anti-inflammatory agent)
- Nexium (esomeprazole – a proton pump inhibitor)
- Norvasc (amlodipine besylate – a calcium channel blocker)
- Natrilix (indapamide hemihydrate – a low-ceiling diuretic)
- Zandip (lercanidipine hydrochloride – a calcium channel blocker)

None of the medications were new to the market–Nexium had been available for 13 months, and all other brands for a minimum of 18 months, prior to the commencement of this study.

Incorporating the final GP and practice characteristic model, the two GP groups were compared on their prescribing behaviour for each of the above medications.

### **6.1.3 Multivariate analyses and Models used**

As described in Chapter 2 the step-wise elimination process was used to obtain the final models for GP and practice characteristics for patient outcomes (Model 6A). Morbidity and management outcomes were not measured in this chapter so no further modelling was required.

#### ***Covariates in Model 6A***

The variables showing significant association ( $p < 0.05$ ) and included as covariates in the final model were:

- GP age;
- number of hours the GP spent in direct patient care per week;
- GP status as having bulk billed for all patients;
- practice location by ASCG; and
- presence of a practice nurse at the major practice address.

Factors such as the patient's age, sex and morbidity will have been considered by the GP when forming the decision to prescribe a medication from the therapeutic class or group. The patient characteristics and morbidity were therefore not included in the modelling for this analysis because the decision to prescribe is not the factor being examined – it is the choice of medication once the prescribing decision has been made.

#### **Group variable of interest**

For all models, the group variable was the use of software containing embedded advertising. GPs not using advertising embedded software made up the reference group against which the group who use advertising embedded software (the experimental group) was compared.

### **6.1.3 Statistical methods**

The problems which resulted in at least one prescription for each of the seven medications under investigation were identified using SAS procedures. The 'at least one' identifier applies because there are problems for which different strengths of the same medication are co-prescribed in

order to obtain the required dosage for the patient. For example, a GP advising a patient to take 60mg of Lipitor would provide a prescription for a 40mg tablet and one for a 20mg tablet, as a 60mg tablet is not available. If more than one medication in the same therapeutic class or group was prescribed for the same problem, so that the medications were not mutually exclusive and could be categorised into both the brand under investigation and another brand or generic substance from the same class or group. These cases were removed from the analysis.

For each of the seven advertised medications selected, prescriptions for the advertised product as a proportion of all prescriptions for all products in its ATC class were compared between the two GP groups e.g. the proportion of HMG CoA (3-hydroxy-3-methylglutaryl coenzyme A) reductase inhibitor (ATC Code: C10AA) prescriptions that were for Lipitor using logistic regression. After the seven nominated products were examined individually, they were grouped together and the total number of prescriptions for the advertised medications was compared as a proportion of all medications prescribed in the combined ATC classes.

The results are expressed as odds ratios where GPs not using advertising software are the reference group held constant as ‘1’.

### Power calculations

As described in Chapter 2, a priori power estimations for two-sample comparison of proportions were performed using STATA 8.0(37) software. Sales information from the advertising software’s vendor indicated that between 70% and 80% of GPs were using their product. We performed power estimates assuming approximately 700 GPs in the advertising software using group and 300 GPs in group using other software or none. The power calculated to find a significant difference between 10% and 20% (Type II error – 1 – power) with sample sizes of 700 and 300 was 0.9786. The power calculated to find a significant difference between 40% of GPs and 60% of GPs (Type II error – 1 – power) with sample sizes of 700 and 300 was 0.9999. The post hoc calculations performed on actual sample sizes of GPs who prescribed a medication from an ATC class of group including the advertised brands are reported in Section 7.4.2.

## 6.2 Results

### 6.2.1 Participants and prescribed medications

The 773 GPs exposed to advertising through the advertising software represented 63.3% of the 1,222 GPs included in this analysis. They prescribed 63,335 medications at 77,300 patient encounters, equating to 62.2% of the 101,230 medications prescribed by the two GP groups. The 449 GPs (36.7%) in the non-exposure group prescribed 37,896 medications at 44,900 encounters, representing 37.4% of the total medications prescribed (Table 6.1).

**Table 6.1: Proportion of GPs in each group and of the medications each prescribed.**

	GPs using Medical Director® (MD) software	GPs not using Medical Director® (MD) software	Total
No. of GPs (row %)	773 (63.3%)	449 (36.7%)	1,222 (100.0%)
No. of medications prescribed (row %)	63,335 (62.6%)	37,895 (37.4%)	101,230 (100.0%)

## 6.2.2 GP prescribing behaviour for selected brands

The prescriptions for each of the seven advertised medications under investigation and all other medications in the same ATC class were identified and numbers of each are shown in Table 6.2. The final denominator for each variable is shown, after removing cases where an advertised product and another medication from the same class or group were prescribed for the same problem. In total, 29 cases were excluded across the seven medication brands, and the numbers excluded for each medication group are listed by ATC class in the footnotes to Table 6.2.

The distribution of prescribing for each of the seven brands of interest and other brands or generics in the same medication class or group are also shown in Table 6.2. There was no significant difference in the prescribing rate of Lipitor (Adj. OR = 0.90;  $p=0.18$ ); Micardis (Adj. OR = 0.98;  $p=0.87$ ); Mobic (Adj. OR = 1.02;  $p=0.83$ ); Norvasc (Adj. OR = 1.02;  $p=0.87$ ); or Natrilix (Adj. OR = 0.80;  $p=0.23$ ) as a proportion of all medications in the ATC classes of these products. For Nexium however, a significant difference between the two GP groups emerged after adjustment (Adj. OR = 0.78;  $p=0.02$ ). The GPs who were continually exposed to the advertisements for this product through their software prescribed significantly less of this brand as a proportion of all PPIs/H2RAs, compared with those GPs who were not subjected to advertisements embedded in clinical software.

When the seven advertised products were combined there was no significant difference in the prescribing behaviour between the two groups either before or after adjustment (Adj. OR = 0.96;  $p=0.42$ ).

### Power calculations

The post hoc power calculated from the sample of prescriptions for:

- HMG CoA reductase inhibitors (n=3,510) was 0.8139 (for Lipitor)
- agents acting on the renin-angiotensin system (n=6,503) was 1.000 (for Micardis)
- anti-inflammatory/anti-rheumatic products, non-steroidal (n=5,146) was 0.9995 (for Mobic)
- proton pump inhibitors/H2 receptor antagonists (n=3,125) was 0.8500 (for Nexium)
- calcium channel blockers (n=2,405) was 0.9570 (for Norvasc)
- low-ceiling diuretics (n=656) was 0.2144 (for Natrilix)
- calcium channel blockers (n=2,404) was 0.9568 (for Zanicidip)
- and for the total combined sample (n=23,749) the power was estimated at 1.000.

**Table 6.2: Distribution of prescriptions by advertised medication brands and other brands within the same ATC drug groups**

Number of problems managed with at least one prescription for...	Number (Per cent of group)	Number (Per cent of group)	Odds Ratio	
	GPs exposed	GPs not exposed	Unadjusted (95% CI) p value	Adjusted <sup>(a)</sup> (95% CI) p value
HMG CoA reductase inhibitors (ATC:C10AA) <sup>b</sup>	2,162 (100.0)	1,348 (100.0)		
Lipitor	983 (45.5)	646 (47.9)	0.91 (0.76–1.07)	0.90 (0.76–1.08)
Other	1,179 (54.5)	702 (52.1)	p = 0.26	p = 0.26
Agents acting on the renin-angiotensin system (ATC: C09) <sup>c</sup>	3,927 (100.0)	2,576 (100.0)		
Micardis	169 (4.3)	125 (4.9)	0.88 (0.62–1.25)	0.98 (0.66–1.45)
Other	3,758 (95.7)	2,451 (95.1)	p = 0.48	p = 0.91
Anti-inflammatory and anti-rheumatic products, non-steroids (ATC code: M01A) <sup>d</sup>	3,107 (100.0)	2,039 (100.0)		
Mobic	458 (14.7)	296 (14.5)	1.02 (0.80–1.30)	1.02 (0.78–1.33)
Other	2,649 (85.3)	1,743 (85.5)	p = 0.89	p = 0.89
Proton pump inhibitors and H2 receptor antagonists (ATC code: A02BC & A02BA) <sup>e</sup>	1,955 (100.0)	1,170 (100.0)		
Nexium	487 (24.9)	330 (28.2)	0.84 (0.69–1.03)	0.78 (0.63–0.96)
Other	1,468 (75.1)	840 (71.8)	p = 0.1	p = 0.02
Calcium channel blockers (ATC code: C08) <sup>f</sup>	1,491 (100.0)	914 (100.0)		
Norvasc	465 (31.2)	279 (30.5)	1.03 (0.85–1.25)	1.01 (0.82–1.25)
Other	1,026 (68.8)	635 (69.5)	p = 0.76	p = 0.91
Total low-ceiling diuretics (C03A & C03B) <sup>g</sup>	424 (100.0)	232 (100.0)		
Natrilix prescription	257 (60.6)	152 (65.5)	0.81 (0.54–1.21)	0.80 (0.51–1.25)
Other	167 (39.4)	80 (34.5)	p = 0.30	p = 0.32
Calcium channel blockers (ATC: C08) <sup>h</sup>	1,492 (100.0)	912 (100.0)		
Zanidip	148 (9.9)	105 (11.5)	0.85 (0.62–1.16)	0.88 (0.62–1.25)
Other	1,344 (90.1)	807 (88.5)	p = 0.30	p = 0.47
All medication decisions included above	14,558 (100.0)	9,191 (100.0)		
Advertised brand medications	2,967 (20.4)	1,933 (21.0)	0.96 (0.88–1.05)	0.96 (0.87–1.06)
Non advertised brand medications	11,591 (79.6)	7,258 (79.0)	p = 0.38	p = 0.42

(a) Model controlling for the following GP/practice characteristics: age, practice location, bulk-billing all patients status, practice accreditation status.

(b) Number of encounters excluded due to co-prescription of Lipitor and other brand within this group–1

(c) Number of encounters excluded due to co-prescription of Micardis and other brand within this group–15

(d) Number of encounters excluded due to co-prescription of Mobic and other brand within this group–4

(e) Number of encounters excluded due to co-prescription of Nexium and other brand within this group–5

(f) Number of encounters excluded due to co-prescription of Norvasc and other brand within this group–1

(g) Number of encounters excluded due to co-prescription of Natrilix and other brand within this group–0

(h) Number of encounters excluded due to co-prescription of Zanidip and other brand within this group–3

Note: AS = advertising software; CI = confidence intervals; ATC = Anatomical Therapeutic Chemical.

## 7 Discussion

Our study has shown how rapidly computers have been integrated into general practice over the past decade. A 1997 AC Neilsen report found that 31% of practices had computers,(5) and initiatives have raised this proportion to 94%. However, while the physical presence of a computer in practices has increased significantly, there is still reluctance among GPs to fully embrace technology for clinical processes.

The aforementioned Productivity Commission Report states that PIP practices in 2004 covered around 80% of Australian general practice patients.(19) The Commission's proportion of PIP practices prescribing electronically (93.2%) was similar to the proportion of GPs in our study who prescribed electronically (94.7%). However, while 92.0% of PIP practices 'had the capacity to send and/or receive clinical information via use of computer technology',(19) only about 67.0% and 60.0% of the GPs in our study were using the internet and/or email respectively – even though 80.9% reported having these facilities available at their major practice. Having this capacity satisfies PIP requirements but does not guarantee its use by individual GPs.

The results of our study show a distrust in the reliability of computer systems, evident in comments about 'down times' and 'crashes', and claims by many that data stored on computer is being 'backed up' with a paper copy. This double handling for already time-constrained GPs highlights their lack of confidence in their computer systems.

GPs also reported practices where patient information is being recorded on paper by some GPs and in a computer by others, for the same patients. This occurs at times when the system is down for some practices, but for others, seems to stem from a lack of agreement between practitioners. A reasonable assumption is that neither version of the patient record is complete, certainly not as comprehensive as could be assumed when all patient information was kept in one format. Only one in five GPs use the computer to its capacity and keep all patient information in the one record. These GPs are the only participants in this study who could provide a comprehensive current data exchange with other areas of the health sector. The paper based or hybrid nature of practice records for the remaining 80% would prohibit the extraction of all pertinent information in an event summary of the type earlier mooted for the now defunct *HealthConnect*.(90)

The problem of hybrid records introduced with the transition to computerisation is one area where technology has negatively affected quality of care. In 1994, Walker described hybrid records as 'a cumbersome byproduct of the evolution to the computer-based patient record'.(91) A decade later we still have many GPs keeping patient information in two separate areas and one could argue that, at least when all the patient's information was in a paper record, it was all in one place. In the UK, Hamilton et al (2003) compared paper, computer and hybrid records for a group of patients over a 2 year period and concluded that the quality of individual consultation record keeping was highest in paper-only systems, suggesting both medico-legal implications and an impact on continuity of care for hybrid and computer only systems.(92) These implications may also apply to the records being kept by Australian GPs. Our research shows that only half of the GPs who claimed to use electronic medical records actually keep all their patient data in electronic format, the remainder using a hybrid system where some information is kept electronically and some in paper format. This equates to 29.8% of the 1,069 GPs who use computers for clinical activity. As a consequence, clinical information for these patients is now in two locations instead of one, which means that relevant information could be overlooked, possibly leading to adverse consequences for both the patient medically, and the GP legally. In this instance, the introduction of technology into a health setting has potentially a very negative affect on the quality of patient care.

Further evidence of incomplete recording was reported by McInnes et al (2006).(93) They found that 98% of the Australian GPs surveyed were prescribing electronically, but only 65% were recording a 'reason' for the prescription (i.e. an indication of the problem being managed). Although the authors did not define 'mostly', they reported that 64.4% of GPs recorded progress notes mostly by computer, 19.6% mostly by paper, and 13.5% both computer and paper, results which also show evidence of hybrid records.(93) The hybrid record also adds further to the debate surrounding the 'intrusion' of the computer, and the way it has changed the dynamic of the consultation.(94-96) Gibson et al noticed that where hybrid records were used, the GP's time becomes split three ways, describing the situation as 'multitasking in the consulting room, i.e. consulting paper patient records in conjunction with the computer, while conversing with the patient.(95)

Substantial upkeep costs, lack of confidence in their computer systems, and lack of knowledge of their software are some reasons for the lack of commitment to electronic systems that were offered by the GPs in this study. These are difficult problems to overcome when programs initiated to assist with cost or GP education are superseded so quickly. Technology is advancing rapidly and many options are becoming outdated before they are fully paid for. It is a costly exercise in both time and money for busy practices to keep updating hardware and software. Walker (1997) described the myriad of application programs, operating system platforms, database computing languages and record systems, each with its own unique structure and set of data elements available for use in primary care, some with free text entry, some with coding systems, and yet others with a mixture of both.(97) A decade later, while some of the names have changed and capacities improved, this variety still exists at every level. Some of these issues will be addressed by the standards programs being undertaken by NEHTA, but a real solution is still some time away.

Privacy and security issues, patients' attitudes to computerisation, and legal issues associated with these concerns, have been well documented in the literature.(98-104) Many of the reasons given for the failure of a project to develop a GP based statewide data collection network, undertaken by three Queensland Divisions in 2001(105) echoed the concerns expressed by the participants in this study. Similar results were found in a US study by Linder et al. (2006).(106) Linder's cross-sectional survey of primary care clinicians using ambulatory care data reported the same concerns regarding time constraints, lack of faith in the performance ability of the technology, loss of data – even their own 'inability to type quickly enough' as was offered by some GPs in our study.(106) It would seem they remain barriers to successful transfer to full computerisation, and will need to be resolved if general practice is to fully adopt e-health initiatives.

For better or worse, and regardless of stimuli to expedite the process, progression of time will eventually see the full computerisation of general practice achieved – there were only two GPs (of 109) under 35 years of age who were not using a computer for clinical activity. Computer use has become an integral part of the school education system and eventually general practice will be populated by clinicians for whom the use of a computer is the norm. A recent study of computer use by medical students showed that they adopt and use electronic information resources much more willingly and frequently than has been reported among practicing clinicians. (107)

In regard to the actual behaviour of GPs, there were differences in many areas between those who used the computer as part of their clinical activity, but relatively few that could be attributed to their clinical use of a computer.

On balance this study suggests that the use of a computer has had little effect at all on the quality of care provided by the GPs to their patients. After adjustment for other characteristics, when the

use of a computer remained the only explanation for differences, clinical computer users performed 'better' on 3 of the 34 quality indicators, and 'worse' on 4 indicators. There was no difference at all in their performance over the remaining 29. Where the indicators were used to compare behaviour on the basis of test ordering through the computer, only one difference emerged and in this instance, those ordering tests through their software performed 'better' than their counterparts. In total, from 44 indicators, 4 were 'better' 4 were 'worse' and no differences were discernable for the remaining 36. Of particular interest was the length of consultation. The GP groups were identical on this indicator but does this imply that there is no difference in the level of quality given to the patients by the GPs, or does it suggest that the extra time involved in dealing with the computer means less 'quality' time spent with the patient over the same duration? A similar cross-sectional analysis was performed by Linder et al in the US, on data from the 2003 and 2004 Ambulatory Medical Care Survey, examining the association of EHR use with 17 ambulatory care quality indicators, with similar results.(108) For 14 of the 17 indicators, there was no difference in performance between visits with and without the use of an EHR. On two indicators, the clinicians using EHRs performed 'better' and on one indicator they performed 'worse'. The US study is supporting evidence for the findings of this work, that the use of a computer in clinical practice has not affected the quality of care insofar as it can be measured via this method.

In primary care, as in other areas of the health system, the use of quality indicators has become accepted as a reasonable approach for assessing quality, although for some time the focus has been on process measures which tell what was done. More recently the focus has shifted to outcome measures, which show the effect of what was done.(109) The indicators designed for use with these data, and selected for this study, were formulated around a frequency of event perspective on a group basis – we have not at any point attempted to single out individual encounters and assess the appropriateness of a particular referral or prescription for a particular patient. As an entity, quality is difficult to measure. The use of quality indicators is an inexact science at best, and the incorrect application of inappropriate quality indicators will not produce a valid or reliable result. However, the set of indicators used in this study were designed originally in consultation with Dr Grant Russell, then RACGP National Manager Quality Care and Research and the RACGP National Standing Committee, and drawing from Australian and international guidelines for preventive activities. These included the RACGP 'Red Book', the Canadian guide to clinical preventive healthcare, an guidelines for National Health Priority areas such as the National Heart Foundation CVD guidelines.(43) The quality indicators were validated in the previous work done for the College(43) and are suitable for use with the data source used in this study, with a sample of practitioners shown to be representative of the practising GP population in Australia.

In designing and selecting indicators, consultation with the most learned and experienced can produce a consensus about which result will best indicate good quality. Parameters for many of the chosen quality indicators are fluid, hence the term 'indicator' rather than a noun of conclusion or goal. These tools are at best a directional pointer, and while much research, debate and discussion has gone into devising best practice guidelines, it may be that neither group has achieved 'best' practice, or that both have, on some or all of these indicators.

Computerisation has not yet shown the benefits various authors expect it to produce. This may be the result of problems being solved in some areas and created in others. For example, the problems of illegible writing on prescriptions are greatly reduced with computerised prescribing the printed prescriptions are clean and easy to read. There are time and cost savings made in the efficiency of electronically produced repeat prescriptions where the patient information is stored in the computer system from previous visits. Drug prompts and alerts help clinicians to prescribe more appropriately.(22-24,110) However, the default setting on some computer systems can

allow the maximum number of repeats to be given inadvertently, generating unnecessary prescriptions for medications which may be expensive and inappropriate for subsequent illnesses e.g. antibiotics.(25,26) The drug alerts embedded in clinical software can be over-ridden by GPs and this can lead to inappropriate prescribing.(111) Glassman et al (2006) found that automated drug alerts made no difference over time to GP behaviour.(112) Liaw and Kerr (2004) reported large variations in the numbers of prompts, clinical relevance and appropriateness of information found in a variety of prescribing packages.(113) Increasing preventive care improves quality and opportunist electronic reminders have the potential to increase preventive care in general practice but Frank et al (2004) found that these opportunities are taken selectively by GPs.(114)

An interesting aspect of this study was the effect of advertising embedded in clinical software on GP prescribing behaviour. We found that exposure to advertisements embedded in clinical software had one small and selective effect on the prescribing behaviour of the GPs in this study. However, this effect was negative rather than positive, and it was subsumed in the overall result when all seven products were grouped.

Incidental exposure of patients to advertisements is one aspect of the ethical debate concerning advertisement embedded software, but exposure to GPs is the dominant one, and echoes the same issues involving pharmaceutical advertising in medical or scientific journals.(72,76-78) The assumption that this method of advertising influences prescribing behaviour is supported by the amount of advertising commissioned by pharmaceutical companies. Glassman et al used the example of advertisements in the New England Journal of Medicine (NEJM) and Journal of the American Medical Association (JAMA), who produce multiple editions of the same journal that have the same text but different pharmaceutical advertisements depending on the geographic region and physician specialty intended for that issue. Primary care physicians receive editions with the most advertisements and libraries receive those with the fewest.(77) This collaboration in promoting pharmaceutical products does not correlate with best practice ideals and creates a potential conflict of interest. Nonetheless, this advertising offsets the cost of the journals and is a significant source of funding for some physician organisations that, in some cases, might not exist without it.(77)

To some extent the same dilemma is assumed for users of advertising software – removing the advertisements would mean removing the subsidy made available through advertising revenue, and the software would then become more expensive for its purchasers. However, despite the obvious amount of revenue contributed by advertisements, the current price of the advertising software aligns with at least two similar clinical software packages currently available in Australia, which do not have advertisements.(115)

There are a couple of other considerations in the ethical debate where advertisement embedded software is concerned. Provision 3.10.11 of Medicines Australia's Code of Conduct(88) is arguably being breached when advertisements are (in some cases), clearly targeted toward a condition or clinical function with which the condition is associated (for example, the only two advertisements being shown in the cardiovascular monitor tool are for Micardis or Norvasc; the only two to appear in the product information tool for musculoskeletal drugs are for Celebrex and Mobic.) The pharmaceutical industry is held responsible for any breaches. But with effective industry standards and accreditation for clinical software perhaps these regulations might be better followed and breaches better controlled.

In this study the advertisements for Nexium had a negative effect on the GPs exposed to advertisements. Some GPs providing feedback to Harvey et al stated that advertisements in their clinical software were 'annoying'.(116) and perhaps our result is associated with an 'annoyance' factor – the strip advertisement for Nexium appeared in the pathology ordering tool continually

throughout the study period, as well as in the routine display through the software's general cycle of advertisements. While warnings and reminders can be switched off in the software, the advertisements are very difficult to eliminate for the average user. In any case, the software has achieved market dominance, so the annoyance factor would appear to have the same influence as the perceived cost saving. The lack of compatibility in software also makes the transition to a different product difficult and to a large extent software vendors have 'locked in' the practices and GPs who are using their products. Computerisation is an expensive process, requiring continued updates of hardware, software and other associated equipment. It has become almost essential and the costs are borne by the practice.

While we could measure differences in the prescribing behaviour for the products nominated, we could not test the effect of other advertisements for the not-for profit organisations. However, we have no reason to assume that these advertisements would have been any more effective in influencing the GPs' behaviour than those for the pharmaceutical products. Given the cost of these advertisements, and that this mode of advertising may not effect an increase in prescriptions for the advertised product this may not be the best use of advertising expenditure. The pharmaceutical industry may afford to absorb the cost for this questionably efficient method of promotion (and one that also exposes it to criticism and potential fines for breaches of the MA Code of Conduct), but organisations being funded by the public purse may not be as able to justify such expenditure.

### **Limitations**

In any observational study, consideration must be given to the influence of confounding factors. The conclusions drawn from this research are that the differences are attributed to the clinicians' use of a computer for clinical activity, having adjusted for the influence of the many other GP, practice, patient and morbidity characteristics collected in BEACH. There always remains the possibility that these results are influenced by a variable not collected in BEACH. For example, we have no knowledge of the business structure or employment status (solo vs partnership vs corporation) of the GPs who participated, or to what extent business structure affects the autonomy of GPs in deciding patient mix, choice of software, choice of provider, or even the choice to use a computer, and the extent to which it is used – and the comments received from some participants would suggest there is not consensus in some practices on the latter.

We have considered whether GPs who participate in BEACH (on paper) may be less likely to be computerised. The majority of BEACH participants have a computer available and use it to some degree, and the methodology has shown the participants of this study to be representative of practicing GPs in Australia, as was also reported for the majority of the sample in the BEACH annual report of 2004-05.(50)

The BEACH method employs the GP as the data collector. Limitations concerning the reliability and validity of practitioner-recorded morbidity were discussed in detail by Britt et al (1999) in 'General practice activity in Australia 1998–99' (pages 10–11)(44), and should always be borne in mind. These include clarity of communication between physician and patient, inter-doctor differences in interpretation of language and signals, regular absence of sufficient information to conclude a diagnosis, and the influence of therapeutic decisions on diagnostic labels. All have input to the final label selected by a clinician to describe the problem under management. However these apply equally to data passively drawn from medical records (whether paper-based or electronic) and to active data collection methods such as BEACH.(117,118) There is as yet no more reliable method of gaining detailed data about morbidity and its management in general practice. 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.(119) There is also no reason to assume that, whatever the limitations concerning this method of data collection, they

would not apply equally to all GPs who participated in this study, regardless of their status as a clinical computer user.

There is also a risk, with such a large database and the sheer volume of variables collected in BEACH, of reporting a difference between groups when in fact, none exists (i.e. incurring a Type 1 error) when the significance level is set at 0.05. However, to reduce the significance level to 0.01 there is the risk of a Type 2 error occurring, (deciding that an outcome was due to chance, when in fact there was a real difference of effect) and of not observing trends or patterns observable in the larger picture.

All survey responses were self reported – we cannot verify that the claims made about the clinical use of the computer reflect their true use. We have also considered the possible exposure to recall bias through collecting information by follow-up about the type and amount of patient data held in electronic medical records.

We could not determine what exposure GPs had to advertising through other mediums, but assumed that GPs in both groups had an equal chance of exposure to advertisements via scientific journals, periodicals, visits from pharmaceutical representatives etc. We did not investigate the appropriateness of the chosen medication for the condition for which it was prescribed – our purpose was to detect any influence of the advertising once the decision to prescribe had been made. We also had no way of examining the effect, if any, on patients exposed to the advertisements, and acknowledge that patient request is a recognised influence on how GPs prescribe.(73-75)

## **8 Conclusion**

This study has demonstrated that, while there are some differences in the clinical behaviour patterns of GPs who use a computer for clinical purposes, many of the real differences are associated with characteristics other than their use of a computer. The use of a computer for clinical purposes has not to date produced any discernable benefit or improvement in the quality of care provided to patients, despite the time and monetary costs associated with their use. In the short term, the hybrid nature of patient records adopted by many GPs is a negative outcome. While uptake of computers has increased rapidly over the past decade, the computer within the practice is not usually being fully utilised. Work is progressing on formulating standards and creating a minimum data set for electronic record use, with the objective of creating an electronically connected health system. The success of this venture is reliant on GPs being more convinced of the reliability of a fully computerised system than they appear to be at present. GPs do not appear to be influenced by the presence of advertisements in their clinical software, which is a positive outcome for those concerned with quality use of medicines, but may indicate a waste of resources by non-for-profit organisations and public institutions who advertise through this medium.

We would recommend that this type of investigation be repeated at a later date, but this will be difficult given the improbability of finding a comparison group of GPs. It will be difficult to determine the long-term effect of computerisation in the future. Other methods will need to be devised.

## Reference List

- (1) Huffman EK. Health Information Management. 10th ed. Berwyn, Illinois: Physicians' Record Company; 1994.
- (2) MacIsaac P. RACGP Computer Assisted Practice Project - CAPP. 87 A.D. Apr 30; Melbourne: RACGP; 87 A.D.
- (3) Richards B, Bolten P, Veale B, Quinlan F. Information technology in general practice. Canberra: Commonwealth Department of Health and Aged Care; 1999.
- (4) MacIsaac P, Crampton M, Kidd M. RACGP Computer assisted practice project 1986-1993. South Melbourne: RACGP; 1994. Available from: <http://www.gpcg.org/publications/docs/CAPPFinal95.pdf>
- (5) Nielsen AC. A study into levels of, and attitudes towards information technology in general practice. Volume 1. Canberra: General Practice Branch, Department of Health and Family Services; 23-2-1998. Available from: <http://www7.health.gov.au/pubs/gpit/gpit1.pdf>
- (6) Primary Health Care Research and Development Centre. Final Report: Community Health and General Practitioners: Partnerships in Care. Melbourne: La Trobe University; 1998. Available from: <http://www.latrobe.edu.au/aipc/Partnerships%20in%20Care.pdf>
- (7) Commonwealth Department of Health and Aged Care (DHAC). General practice in Australia: 2000. Canberra: DHAC; 2000.
- (8) Commonwealth Department of Health and Aged Care. General Practice. Changing the future through partnerships. The report of the General Practice Strategy Review Group. Canberra: Commonwealth Department of Health and Aged Care; 1999.
- (9) General Practice Strategy Review Group. General Practice. Changing the future through partnerships. Canberra: Commonwealth Department of Health and Family Services; 1998.
- (10) Health Insurance Commission. An outline of the Practice Incentives Program. Canberra: HIC; 2001. Available from: [http://www.hic.gov.au/providers/resources/incentives\\_allowances/pip/outline\\_pip\\_whole.pdf](http://www.hic.gov.au/providers/resources/incentives_allowances/pip/outline_pip_whole.pdf)
- (11) RACGP & AMA. Implementation of Computerisation. Principles for Implementation of Computerisation in General Practice: a plan for the next three years. Royal Australian College of General Practitioners and Australian Medical

- Association; 1998; [updated 1998; cited 2005 Apr 11]. Available from:  
<http://www.racgp.org.au/printdocument.asp?id=2399>
- (12) RACGP. A Quality Framework for Australian General Practice. Background paper. RACGP; 2004. Available from:  
<http://www.racgp.org.au/downloads/pdf/20041108qualitycareliteraturereview.pdf>
- (13) General Practice Computing Group. About GPCG. 2003 Feb 27; [updated 2003 Feb 27; cited 3 A.D. Nov 17]. Available from:  
[http://www.gpcg.org/about\\_gpcg/index.html](http://www.gpcg.org/about_gpcg/index.html)
- (14) Commonwealth Department of Health and Aged Care. Health Online. A health information action plan for Australia. Fact sheet - Key projects. 2003; [updated 2003; cited 2003 Nov 3]. Available from: [www.health.gov.au/healthonline](http://www.health.gov.au/healthonline)
- (15) General Practice Computing Group. HealthConnect. 2003 Jul 15; [updated 2003 Jul 15; cited 2003 Nov 3]. Available from:  
<http://www.gpcg.org/topics/HealthConnect.html>
- (16) National E-Health Transition Authority. Background: NEHTA. National E-Health Transition Authority Ltd; 2006; [updated 2006; cited 2007 Mar 12]. Available from:  
[http://www.nehta.gov.au/index.php?option=com\\_docman&task=cat\\_view&gid=153&Itemid=139](http://www.nehta.gov.au/index.php?option=com_docman&task=cat_view&gid=153&Itemid=139)
- (17) May L. The National E-Health Transition Authority (NEHTA). Health Info Man 2005;34(1):19-20.
- (18) Commonwealth Department of Health and Aged Care. General Practice in Australia 2004. Canberra: DoHA; 2004.
- (19) Steering Committee for the Review of Government Service Provision. Report on Government Services 2006. Canberra: Commonwealth of Australia; 2006.
- (20) Heathfield H, Pitty D, Hanka R. Evaluating information technology in health care: barriers and challenges. BMJ 1998 Jun;316(7149):1959-1961.
- (21) Mitchell E, Sullivan F. A descriptive feast but an evaluative famine: systematic review of published articles on primary care computing during 1980-97. BMJ 2001 Feb;322(7281):279-282.
- (22) Institute for Safe Medication Practices. A call to action: Eliminate Handwritten Prescriptions within 3 years! 2000; [updated 2000; cited 2005 Apr 4]. Available from: <http://www.ismp.org/msaarticles/WhitepaperPrint.htm>
- (23) Wyatt J, Walton R. Computer based prescribing. BMJ 1995 Nov;311(7014):1181-1182.
- (24) Teich JM, Merchia PR, Schmitz JL, Kuperman GJ, Spurr CD, Bates DW. Effects of computerized physician order entry on prescribing practices. Arch Intern Med 2000 Oct;160(18):2741-2747.

- (25) National Prescribing Service Limited. Antibiotic prescribing in general practice. 2003 May; [updated 2003 May; ]. Available from: [http://nps.org.au/Doc/pdfs/PPR21\\_Antibiotics.pdf](http://nps.org.au/Doc/pdfs/PPR21_Antibiotics.pdf)
- (26) Newby DA, Fryer JL, Henry DA. Effect of computerised prescribing on use of antibiotics. *Med J Aust* 2003 Mar;178(5):210-213.
- (27) Koppel R, Metlay JP, Cohen A, Abaluck B, Localio AR, Kimmel SE, et al. Role of computerized physician order entry systems in facilitating medication errors. *JAMA* 2005 Mar;293(10):1197-1203.
- (28) Han YY, Carcillo JA, Venkataraman ST, Clark RS, Watson RS, Nguyen TC, et al. Unexpected increased mortality after implementation of a commercially sold computerized physician order entry system. *Pediatrics* 2005 Dec;116(6):1506-1512.
- (29) Britt H, Sayer GP, Miller GC, Charles J, Scahill S, Horn F et al. BEACH Bettering the Evaluation and Care of Health: A study of general practice activity, six-month interim report. Canberra: Australian Institute of Health and Welfare; 1999.
- (30) Britt H, Miller GC, Knox S, Charles J, Valenti L, Henderson J et al. General practice activity in Australia 2000-2001. Canberra: Australian Institute of Health and Welfare; 2001.
- (31) SAS Proprietary Software Release 6.12. Cary: SAS Institute Inc, 1996.
- (32) SAS Proprietary Software Release 8.2. Cary: SAS Institute Inc, 2001.
- (33) Britt H, Miller GC, Knox S, Charles J, Valenti L, Pan Y et al. General Practice Activity in Australia 2003-04. Canberra: Australian Institute of Health and Welfare; 2004. Available from: <http://www.aihw.gov.au/publications/index.cfm/title/10079>
- (34) Sayer GP. Estimating and generalising with clustered sampling in general practice. *Aust Fam Physician* 1999;28(Suppl1):S32-S34.
- (35) Knox SA, Chondros P. Observed intra-cluster correlation coefficients in a cluster survey sample of patient encounters in general practice in Australia. *BMC Med Res Methodol* 2004 Dec;4(1):30.
- (36) Kish L. Survey Sampling. New York: John Wiley & Sons; 1965.
- (37) Stata Statistical Software: Release 8.0. College Station, TX: Stata Corporation, 2003.
- (38) Cohen J. Statistical power analyses for the Behavioural Sciences. Revised Edition ed. New York, NY: Academic Press; 1977.
- (39) Cohen J. The statistical power of abnormal-social psychological research: a review. *J Abnorm Soc Psychol* 1962 Sep;65:145-153.

- (40) Australian Bureau of Statistics (ABS). Australian Standard Geographical Classification (ASGC). Canberra: Australian Bureau of Statistics.; 2004.
- (41) Australian Bureau of Statistics. Census of population and housing: Socio-Economic Indexes for Areas (SEIFA), Australia. Canberra: Australian Bureau of Statistics; 2001. Available from:  
<http://www.abs.gov.au/Ausstats/abs@.nsf/0/50a3a7c289058c0cca256db80006fd62?OpenDocument>
- (42) Britt H, Bhasale A, Miles DA, Meza A, Sayer GP, Angelis M. The sex of the general practitioner. A comparison of characteristics, patients, and medical conditions managed. *Med Care* 1996;34(5):403-415.
- (43) Miller G, Britt H, Pan Y, Knox S. FRACGP: Does it make a difference. A comparative study of practice patterns of GPs who are Fellows of the Royal Australian College of General Practitioners and of those who are not. Westmead: Family Medicine Research Centre; 2002. Available from:  
<http://www.racgp.org.au/Content/ContentFolders/Reportssubmissionsandoutcomes/200709FRACGPFinalreport.pdf>
- (44) Britt H, Sayer GP, Miller GC, Charles J, Scahill S, Horn F et al. General practice activity in Australia 1998-99. Canberra: Australian Institute of Health and Welfare; 1999.
- (45) Pont LG, Denig P, van der MT, van der Veen WJ, Haaijer-Ruskamp FM. Validity of performance indicators for assessing prescribing quality: the case of asthma. *Eur J Clin Pharmacol* 2004 Jan;59(11):833-840.
- (46) Schoen C, Osborn R, Huynh PT, Doty M, Peugh J, Zapert K. On the front lines of care: primary care doctors' office systems, experiences, and views in seven countries. *Health Aff (Millwood)* 2006 Nov;25(6):w555-w571.
- (47) Blendon RJ, Schoen C, Donelan K, Osborn R, DesRoches CM, Scoles K, et al. Physicians' views on quality of care: a five-country comparison. *Health Aff (Millwood)* 2001 May;20(3):233-243.
- (48) Lawrence M, Olesen F. Indicators of quality in health care. *Eur J Gen Pract* 1997;3(3):103-108.
- (49) Pringle M, Wilson T, Grol R. Measuring "goodness" in individuals and healthcare systems. *BMJ* 2002 Sep;325(7366):704-707.
- (50) Britt H, Miller G, Knox S, Charles J, Pan Y, Henderson J et al. General Practice Activity in Australia 2004-05. Canberra: Australian Institute of Health and Welfare; 2005. Available from:  
<http://www.aihw.gov.au/publications/index.cfm/title/10189>
- (51) Williams D, Bennett K, Feely J. The application of prescribing indicators to a primary care prescription database in Ireland. *Eur J Clin Pharmacol* 2005 Apr;61(2):127-133.

- (52) Engels Y, Campbell S, Dautzenberg M, van den HP, Brinkmann H, Szecsenyi J, et al. Developing a framework of, and quality indicators for, general practice management in Europe. *Fam Pract* 2005 Apr;22(2):215-222.
- (53) McGlynn EA. Selecting common measures of quality and system performance. *Med Care* 2003 Jan;41(1 Suppl):I39-I47.
- (54) Barnsley J, Berta W, Cockerill R, MacPhail J, Vayda E. Identifying performance indicators for family practice: Assessing levels of consensus. *Can Fam Physician* 2005;51(May):71.
- (55) Houghton G, Rouse A. Are NHS primary care performance indicator scores acceptable as markers of general practitioner quality? *Br J Gen Pract* 2004 May;54(502):341-344.
- (56) Kirk SA, Campbell SM, Kennell-Webb S, Reeves D, Roland MO, Marshall MN. Assessing the quality of care of multiple conditions in general practice: practical and methodological problems. *Qual Saf Health Care* 2003 Dec;12(6):421-427.
- (57) Canadian Institute for Health Information. Pan-Canadian Primary Health Care Indicators. Ottawa, Ontario: Canadian Institute for Health Information; 2006. Available from:  
[http://secure.cihi.ca/cihiweb/products/PHC\\_Indicator\\_Report\\_1\\_Volume\\_1\\_Final\\_E.pdf](http://secure.cihi.ca/cihiweb/products/PHC_Indicator_Report_1_Volume_1_Final_E.pdf)
- (58) Britt H, Miller GC, Knox S. Imaging orders by general practitioners in Australia 1999-00. Canberra: Australian Institute of Health and Welfare; 2001.
- (59) Britt, H., Miller, G. C., McGeechan, K., and Sayer, G. P. Pathology ordering by general practitioners in Australia 1998. AIHW Cat. No. GEP 4. [monograph on the Internet]. Canberra: Department of Health and Aged Care; 1999; [updated 1999; cited 2000 Oct 30]. Available from:  
<http://www.health.gov.au:80/haf/docs/pathorder.htm>
- (60) Charles J, Valenti L, Britt H. GP visits by health care card holders. A secondary analysis of data from Bettering the Evaluation and Care of Health (BEACH), a national study of general practice activity in Australia. *Aust Fam Physician* 2003 Jan;32(1-2):85-8, 94.
- (61) Miller G, Britt H, Pan Y, Knox S. Relationship between general practitioner certification and characteristics of care. *Med Care* 2004 Aug;42(8):770-778.
- (62) Zwar N, Wolk J, Gordon J, Sanson-Fisher R, Kehoe L. Influencing antibiotic prescribing in general practice: a trial of prescriber feedback and management guidelines. *Fam Pract* 1999 Oct;16(5):495-500.
- (63) Mandryk JA, Mackson JM, Horn FE, Wutzke SE, Badcock CA, Hyndman RJ, et al. Measuring change in prescription drug utilization in Australia. *Pharmacoepidemiol Drug Saf* 2006 Jul;15(7):477-484.

- (64) Shiffman RN, Liaw Y, Brandt CA, Corb GJ. Computer-based guideline implementation systems: a systematic review of functionality and effectiveness. *J Am Med Inform Assoc* 1999 Mar;6(2):104-114.
- (65) Avorn J, Chen M, Hartley R. Scientific versus commercial sources of influence on the prescribing behavior of physicians. *Am J Med* 1982 Jul;73(1):4-8.
- (66) Wazana A. Physicians and the pharmaceutical industry: is a gift ever just a gift? *JAMA* 2000 Jan;283(3):373-380.
- (67) Prosser H, Walley T. Understanding why GPs see pharmaceutical representatives: a qualitative interview study. *Br J Gen Pract* 2003 Apr;53(489):305-311.
- (68) McGettigan P, Golden J, Fryer J, Chan R, Feely J. Prescribers prefer people: The sources of information used by doctors for prescribing suggest that the medium is more important than the message. *Br J Clin Pharmacol* 2001 Feb;51(2):184-189.
- (69) Breen KJ. The medical profession and the pharmaceutical industry: when will we open our eyes? *Med J Aust* 2004 Apr;180(8):409-410.
- (70) Black H. Dealing in drugs. *Lancet* 2004 Nov;364(9446):1655-1656.
- (71) Robertson J, Treloar CJ, Sprogis A, Henry DA. The influence of specialists on prescribing by GPs. A qualitative study. *Aust Fam Physician* 2003 Jul;32(7):573-576.
- (72) Jones M, Greenfield S, Bradley C. A survey of the advertising of nine new drugs in the general practice literature. *J Clin Pharm Ther* 1999 Dec;24(6):451-460.
- (73) Little P, Dorward M, Warner G, Stephens K, Senior J, Moore M. Importance of patient pressure and perceived pressure and perceived medical need for investigations, referral, and prescribing in primary care: nested observational study. *BMJ* 2004 Feb;328(7437):444.
- (74) Prosser H, Almond S, Walley T. Influences on GPs' decision to prescribe new drugs-the importance of who says what. *Fam Pract* 2003 Feb;20(1):61-68.
- (75) Cockburn J, Pit S. Prescribing behaviour in clinical practice: patients' expectations and doctors' perceptions of patients' expectations--a questionnaire study. *BMJ* 1997 Aug;315(7107):520-523.
- (76) Wilkes MS, Doblin BH, Shapiro MF. Pharmaceutical advertisements in leading medical journals: experts' assessments. *Ann Intern Med* 1992 Jun;116(11):912-919.
- (77) Glassman PA, Hunter-Hayes J, Nakamura T. Pharmaceutical advertising revenue and physician organizations: how much is too much? *West J Med* 1999 Oct;171(4):234-238.

- (78) Smith R. Medical journals and pharmaceutical companies: uneasy bedfellows. *BMJ* 2003 May;326(7400):1202-1205.
- (79) Rogers WA, Mansfield PR, Braunack-Mayer AJ, Jureidini JN. The ethics of pharmaceutical industry relationships with medical students. *Med J Aust* 2004 Apr;180(8):411-414.
- (80) Lexchin J, Bero LA, Djulbegovic B, Clark O. Pharmaceutical industry sponsorship and research outcome and quality: systematic review. *BMJ* 2003 May;326(7400):1167-1170.
- (81) Katz D, Mansfield P, Goodman R, Tiefer L, Merz J. Psychological aspects of gifts from drug companies. *JAMA* 2003 Nov;290(18):2404-2405.
- (82) Dana J, Loewenstein G. A social science perspective on gifts to physicians from industry. *JAMA* 2003 Jul;290(2):252-255.
- (83) Roughead EE, Harvey KJ, Gilbert AL. Commercial detailing techniques used by pharmaceutical representatives to influence prescribing. *Aust N Z J Med* 1998 Jun;28(3):306-310.
- (84) Magennis A. Comments on "Pharmaceutical promotion in prescribing software". 2005 Mar 2; La Trobe University; 2005.
- (85) Harvey KJ. The Pharmaceutical Benefits Scheme 2003-2004. *Aust New Zealand Health Policy* 2005 Jan;2(1):2.
- (86) Health Communication Network. Medical Director - Product details. 2006; [updated 2006; cited 2003 Sep 22]. Available from: [http://www.hcn.com.au/products/md/md\\_details.asp](http://www.hcn.com.au/products/md/md_details.asp)
- (87) Harvey K. Pharmaceutical promotion in prescribing software. 2005 Mar 2; La Trobe University; 2005.
- (88) Medicines Australia Inc. Medicines Australia Code of Conduct. Edition 14 ed. Canberra: Medicines Australia Inc; 2003.
- (89) Commonwealth of Australia. Therapeutic Goods Act 1989. 1989; [cited 2007 Mar 21]. Available from: [http://www.comlaw.gov.au/ComLaw/Legislation/ActCompilation1.nsf/0/C44F0188DD3AFB41CA2571E2001EAC50/\\$file/TherapeuticGoods1989\\_WD02\\_Version2.pdf](http://www.comlaw.gov.au/ComLaw/Legislation/ActCompilation1.nsf/0/C44F0188DD3AFB41CA2571E2001EAC50/$file/TherapeuticGoods1989_WD02_Version2.pdf)
- (90) Commonwealth Department of Health and Ageing. HealthConnect Interim Research Report. Canberra: Commonwealth of Australia; 2003. Available from: [http://www.healthconnect.gov.au/pdf\\_docs/v1.pdf](http://www.healthconnect.gov.au/pdf_docs/v1.pdf).
- (91) Walker NS. An integrated clinical computer system: implications for a medical information services department. *J AHIMA* 1994 Dec;65(12):41-43.

- (92) Hamilton WT, Round AP, Sharp D, Peters TJ. The quality of record keeping in primary care: a comparison of computerised, paper and hybrid systems. *Br J Gen Pract* 2003 Dec;53(497):929-933.
- (93) McInnes DK, Saltman DC, Kidd MR. General practitioners' use of computers for prescribing and electronic health records: results from a national survey. *Med J Aust* 2006 Jul;185(2):88-91.
- (94) Sullivan F. Intruders in the consultation. *Fam Pract* 1995 Mar;12(1):66-69.
- (95) Gibson M, Jenkins KN, Wilson R, Purves I. Multi-tasking in practice: coordinated activities in the computer supported doctor-patient consultation. *Int J Med Inform* 2005 Jul;74(6):425-436.
- (96) Pearce C, Trumble S. Computers can't listen--algorithmic logic meets patient centredness. *Aust Fam Physician* 2006 Jun;35(6):439-442.
- (97) Walker D. Transferring electronic medical records. *Aust Fam Physician* 1997 Jan;26(1):48-55.
- (98) Richards H, King G, Reid M, Selvaraj S, McNicol I, Brebner E, et al. Remote working: survey of attitudes to eHealth of doctors and nurses in rural general practices in the United Kingdom. *Fam Pract* 2005 Feb;22(1):2-7.
- (99) Porteous T, Bond C, Robertson R, Hannaford P, Reiter E. Electronic transfer of prescription-related information: comparing views of patients, general practitioners, and pharmacists. *Br J Gen Pract* 2003 Mar;53(488):204-209.
- (100) Anderson JG. Social, ethical and legal barriers to E-health. *Int J Med Inform* 2006 Oct.
- (101) Fairweather NB, Rogerson S. A moral approach to electronic patient records. *Med Inform Internet Med* 2001 Jul;26(3):219-234.
- (102) Sprague L. Electronic health records: How close? How far to go? *NHPF Issue Brief* 2004 Sep(800):1-17.
- (103) Bomba D, de Silva A. An Australian case study of patient attitudes towards the use of computerised medical records and unique identifiers. *Medinfo* 2001;10(Pt 2):1430-1434.
- (104) Bevis MCJ. Patient attitudes towards the use of electronic health records in general practice. 4 A.D. Jul 26; Brisbane: 2004.
- (105) Australian Divisions of General Practice Ltd. From desktop to disease prevention: Development of a GP based statewide data collection network. *ADGP*; 2002; [updated 2002; cited 2005 Aug 23]. Available from: [http://innovations.adgp.com.au/site/index.cfm?display=169&PageMode=indiv&page\\_id=656](http://innovations.adgp.com.au/site/index.cfm?display=169&PageMode=indiv&page_id=656)

- (106) Linder JA, Schnipper JL, Tsurikova R, Melnikas AJ, Volk LA, Middleton B. Barriers to Electronic Health Record Use during Patient Visits. *AMIA Annu Symp Proc* 2006;499-503.
- (107) Peterson MW, Rowat J, Kreiter C, Mandel J. Medical students' use of information resources: is the digital age dawning? *Acad Med* 2004 Jan;79(1):89-95.
- (108) Linder JA, Ma J, Bates DW, Middleton B, Stafford RS. Electronic health record use and the quality of ambulatory care in the United States. *Arch Intern Med* 2007 Jul;167(13):1400-1405.
- (109) Davies HT, Lampel J. Trust in performance indicators? *Qual Health Care* 1998 Sep;7(3):159-162.
- (110) Bates DW, Teich JM, Lee J, Seger D, Kuperman GJ, Ma'Luf N, et al. The impact of computerized physician order entry on medication error prevention. *J Am Med Inform Assoc* 1999 Jul;6(4):313-321.
- (111) Magnus D, Rodgers S, Avery AJ. GPs' views on computerized drug interaction alerts: questionnaire survey. *J Clin Pharm Ther* 2002 Oct;27(5):377-382.
- (112) Glassman PA, Belperio P, Simon B, Lanto A, Lee M. Exposure to automated drug alerts over time: effects on clinicians' knowledge and perceptions. *Med Care* 2006 Mar;44(3):250-256.
- (113) Liaw ST, Kerr S. Computer aided prescribing: decision support needs to be evidence based. *BMJ* 2004 Jun;328(7455):1566.
- (114) Frank O, Litt J, Beilby J. Opportunistic electronic reminders. Improving performance of preventive care in general practice. *Aust Fam Physician* 2004 Jan;33(1-2):87-90.
- (115) Harvey K. Pharmaceutical promotion in prescribing software. 2005 Mar 2; La Trobe University; 2005.
- (116) Harvey KJ, Vitry AI, Roughead E, Aroni R, Ballenden N, Faggotter R. Pharmaceutical advertisements in prescribing software: an analysis. *Med J Aust* 2005 Jul;183(2):75-79.
- (117) Britt H, Meza RA, Del Mar C. Methodology of morbidity and treatment data collection in general practice in Australia: a comparison of two methods. *Fam Pract* 1996 Oct;13(5):462-467.
- (118) Gehlbach SH. Comparing methods of data collection in an academic ambulatory practice. *J Med Educ* 1979;54:730-732.
- (119) Britt H, Angelis M, Harris E. The reliability and validity of doctor-recorded morbidity data in active data collection systems. *Scand J Prim Health Care* 1998 Mar;16(1):50-55.