The Missing Link: Improving General Practice Information Through Changes to the Medical System Interface

Sophie Cockcroft[1]
Kaine Elston[2]

[1]Department of Commerce,
University of Queensland,
St Lucia, Brisbane,
Australia
Email: s.cockcroft@commerce.edu.au

[2]Department of Information Science,
University of Otago,
Dunedin,
New Zealand
Email: kelston@infoscience.otago.ac.nz

Abstract

Most general practices in New Zealand record consultations electronically. Research organisations seek to report on the resultant data for a variety of purposes. The evolution of general practice systems, from paper to computerised notes has been focused largely on medical transactions. To date there has not been a simple means for medical research organisations to extract information from this data. This has resulted in very labour intensive analyses. This paper describes an information quality problem in New Zealand general practice and a prototype implementation of an initial solution.

Keywords

RCC; Read Clinical Classification; Read Codes; RNZCGP; reduced-set RCC; data quality; information quality; data modelling

INTRODUCTION

In 1994 82% of general practices in New Zealand recorded consultations electronically (Tilyard et al., 1994). This is a relatively high level of computerisation. Data such as patient details, consultation notes, lab requests, lab results, immunisation, allergies, screening, reportable diseases, and prescription items are stored routinely in practice systems. From preliminary investigations it is apparent that General practice medical systems have been largely developed to replace a paper-based model. A more colloquial way of putting this is that they are basically "paper on the screen". This type of model has supported clinical practice well for a long time. However, there appears to have been little or no attempt to develop systems that support clinical research. Additionally, the supporting data structure of medical systems is such that it doesn't allow easy extraction of information by clinicians, managers, funders, researchers and planners.

For those bodies charged with the task of controlling government expenditure on drugs, much painstaking data preparation and analysis is required to produce the summary statistics required to adequately advise general practitioners. Difficulty arises in producing summary statistics on what drugs are being prescribed, in what quantity, for which conditions, in a timely manner. The approach used by SouthLink health and the Best Practice Advocacy Centre (BPAC) [BPAC, 2000] is to work backwards, using data from the national pharmaceutical database in Christchurch, to estimate what drugs have been prescribed for what reason. They produce statistics on prescribing patterns which are sent back to the general practitioner, to inform them of their patterns of prescribing relative to other practitioners and assist them in keeping costs down where appropriate. It is contended that, assuming that this information is useful to GPs, it would be better for health professionals to be able to generate such analyses at their own desktop when required.

Aside from issues of funding, if prescribing information could be extracted and stored in a national database for national studies it would provide the perfect resource for research organisations that seek to improve health care for New Zealanders. There are already well-established organisations that collect general practice data for scientific research purposes. An example of this is the Royal New Zealand College of General Practitioners Computer Research Unit (RNZCGP Computer Research Unit). This unit maintains a research network, which is a large collective of general practices. Members of a research network submit data on a regular basis to a centralised repository that manages the data in a secure and ethical manner. A number of such networks exist around the world (Tilyard and Dovey, 1999). The RNZCGP research unit is well known centre for quality general practice research. Studying the large body of data amassed by this group has formed the basis of the observations on information quality described in this paper. It is suggested that implementation of the ideas presented have the potential to make extraction of relevant data for reporting by this group even more efficient.

THE *MISSING LINK* - A DATA QUALITY ISSUE

This research has identified a data-modelling issue, which leads to a problem that plagues the medical research community. It is the problem of defining a relationship between diagnosis and prescription. In the existing medical information systems information regarding the diagnosis is locked in textual consultation notes. The analysis of this data by computer, though a great improvement on paper models, is still very labour intensive, and makes timely analysis challenging.

Current information gathering processes involve searching for strings relating to diagnoses in textual consultation notes. This may mean that consultations are missed when the healthcare professional uses shorthand, or when there is a spelling error. Sometimes, the term that is being searched for may be missing completely from consultation notes. In addition simple push button queries identifying summary statistics, such as prescribing patterns, cannot be executed when information is stored in this fashion. As an example, researchers may wish to know all the drugs used in the treatment of a condition in the geographical location of Taihape, including the frequencies in which they were prescribed and the total cost of each respective drug. In order to produce a report containing the information required above, it would be necessary for every

prescription item to be associated with a reason for encounter (RFE) which currently it is not. A means of ensuring complete, coded entry of consultations is also desirable to ensure that there would not be missing data in such a report. Currently it is not a speedy process to do either of these.

The introduction of the Read Clinical Classification (RCC) into all New Zealand general practice software has meant, at least potentially, that diagnosis information is captured with a computer readable code. The RCC, used in the context of the consultation notes, is essentially a computer readable abstraction. In this fashion many RCC codes can be associated with any one consultation. It is important to note that RCC is vast in its coverage and that when it is used as an abstraction of the clinical notes. It is possible to record classifications that are not specifically diagnoses. An example of this is the emotional state of the patient. Such information is of course important, but coupled with other codes it can confound the relationship between any drugs that may have been prescribed and the diagnosis of the patient. In data modelling terms, a parallel linkage (Kennedy, 1996, Kennedy, 1993) is also found between patient RFE and prescription item. Although it is possible to determine which RCC codes and which items pertain to which consultation, it is impossible to specifically relate with any real degree of accuracy, which RCC code pertains to which consultation prescription item (see highlighted entities in Figure 6). This reduces the usefulness of the information recorded with RCC codes. This will apply to most other classification schemes used in the same manner.

In addition, there is no incentive for healthcare professionals to classify consultations using RCC codes at present. It also represents a significant overhead in effort. As a result RCC coding is rarely carried out.

A method of addressing the classification-coding problem mentioned in the previous paragraphs is to use a classification scheme that specifically relates to general practice. Alternatively and probably preferably, one could use only the codes for diagnoses and suitable reasons for encounter related to general practice of an already well used and well-defined clinical classification scheme - effectively a reduced set of classification codes. One approach is the International Classification of Primary Care (ICPC) described in Britt (1998). Tilyard and Cunningham (1999) of the Royal New Zealand College of General Practitioners (RNZCGP) have described such another modification of clinical classification schemes in this case the use of “cut-down” Read codes for primary care. While this clears the problem of confounding codes that are not specifically diagnoses it does not solve the problem of the parallel linkage.

Ideally each reason for encounter needs to be directly related to one single prescription item. However, it should be noted that this relationship couldn't be re-formed from historical data sets. Current methods that aim to establish this relationship after data entry include; inference using the prescription (i.e. what it is most frequently prescribed for), data mining and other search programs described in (Dovey and Tilyard, 1996). The work described here aims to reduce the time involved in such endeavours and increase the accuracy of the information obtained. The only means by which this information can be captured is for a healthcare professional to consider a reason for each and every item that they prescribe. This should be achieved with minimum impact on the medical professional's time and patient interaction.

The solution described in the previous paragraph seems to be the only method of providing this link, which is of course vital to researchers. The only way to accurately obtain the information is to capture that information from the healthcare professional. The question arises of how we can capture this information without making an unnecessary data entry burden on the healthcare professional involved. Much work has been done in this area including; development and use of cut down coding systems (Britt, 1998; Cunningham and Tilyard, 1999) and intelligent interfaces (George and Warren, 2000). The work presented here follows the use of a reduced set of classification codes such as the system proposed by Tilyard and Cunningham of the RNZCGP (Cunningham and Tilyard, 1999). The advantage of using a reduced classification set is that it increases the speed at which a healthcare practitioner can code a diagnosis. Additionally, because of the reduced size, the classification set can be displayed a drop-down menu, which in turn vastly increases the speed and accuracy of clinical codification. Thirdly, it allows classification concepts to be referred to and selected by their formal textual descriptions. The information system can in turn record the classification code "behind the scenes". This eases coding because the practitioner never has to see any abstract code, basically coding can happen without the knowledge of the user.

While relieving the burden on the coding process, this again does not address relationship issue between reason for encounter and prescription item. In the following section a solution to the information capture problem is presented.

CAPTURING THE VITAL LINK

This paper now describes how to capture the vital information needed to create the link between reason for encounter and prescription items. As stated earlier in the paper, the only way to get this information is for the healthcare practitioner to physically enter it.

A small prototype was developed in order to illustrate the drop-down menu classification, which uses a reduced set RCC as well as some other changes to be described later in this article. The scope of the prototype covers only a small number of functions that are normally present in a fully featured general practice information system. Features such as the patient detail entry screen (as present on a front desk terminal at a general practice), the *waiting room* of patients, the invoicing functions, lab test requests and results, and various registers such immunisations and allergies have been omitted from the prototype. These were omitted because these specific features are already well developed for the most part or are under some form of redevelopment already. It is hoped that the ideas presented in the prototype could be relatively easily incorporated into popular systems already adopted in many practices. Such changes would require government agencies to instigate discussion with the major vendors as suggested by Tilyard et al (1998)

Before progressing, it is necessary to describe the main screens in the prototype system. These are the *patient frontsheet* (see Figure 1) and the *select prescription items* screen (see Figure 2). These screens and their components aim to emulate current systems as much as possible while incorporating the new ideas.

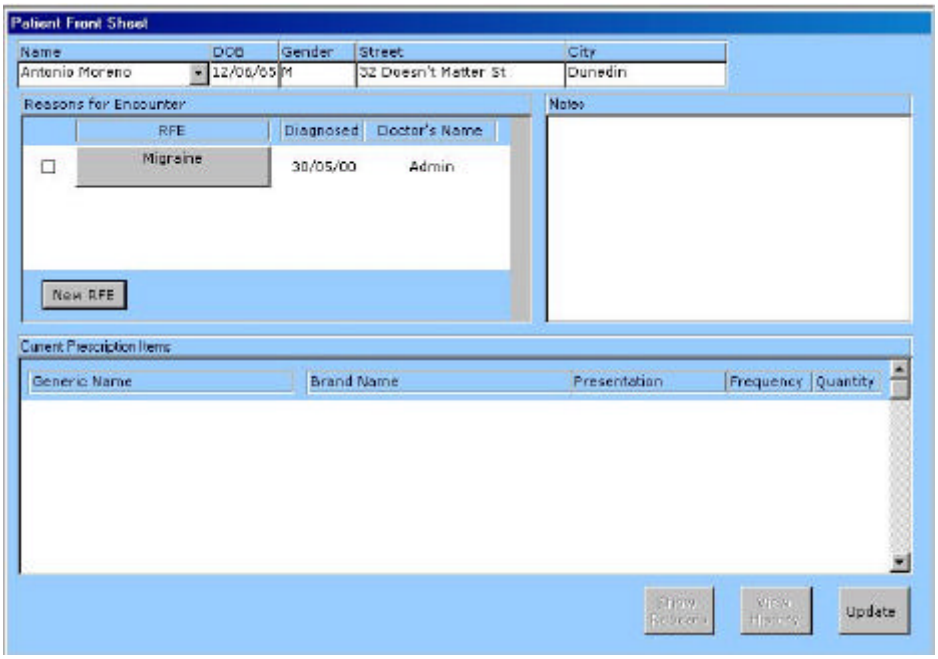

Figure 1: Patient frontsheet screen.

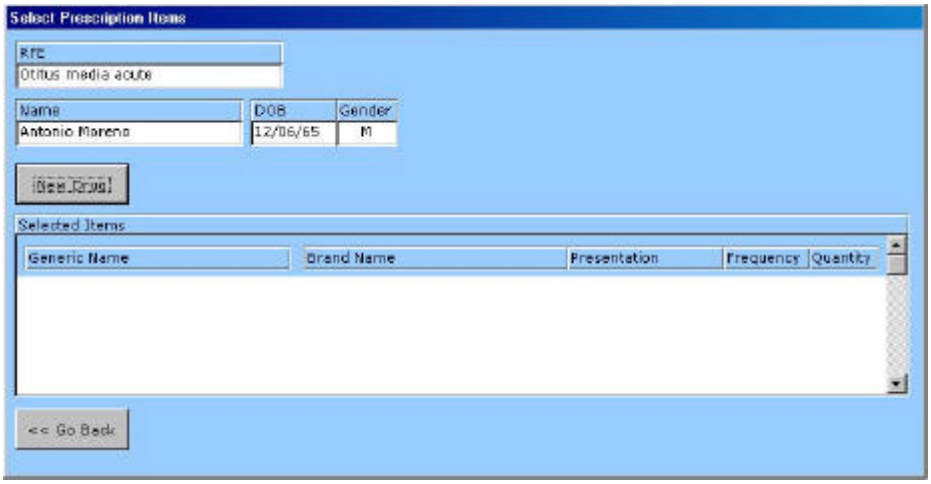

Figure 2: Select prescription items screen.

The *patient frontsheet* is the screen first presented to the user with when a patient is selected from a list of all patients. Front desk staff at a general practice typically edit the list of patients. The *frontsheet* describes patient details like name, date of birth, address and contact details. Contained within this screen is a *problem list*, a *notes* field, and a list of prescription items that have been selected during the consultation. The *problem list* is a list of diagnoses/reasons for encounter of a patient's previous complaints. The problem list presents a basic history of the patient, and helps to ensure that duplicate problems are not reproduced in the database. In this way it catalogues a patient's history. Typically a patient's recurring problems are added to this list. The *notes* field is used to record clinical notes during a consultation. The *select prescription items* screen is a screen

containing components that enable a health professional to select drugs from a list and add them to a patient's prescription.

So far, not much is different from typical general practice systems. The solution to the problem of the missing link lies more in the way these features are used. To prescribe a drug, in current systems, a screen with available drugs is invoked and the items are added to the prescription regardless of the reason. What this prototype does is to guide the user to the *select prescription items* screen *through* one of the problems on the problem list.

The process is now illustrated with an example. A patient presents with symptoms typical of middle ear infection. The problem is added to the problem list by use of the new drop down-menu; *Otitus Media* is added to the list and is possibly one of many problems present, see Figure 3 and Figure 4. Notes about the patient's condition are recorded and antibiotics are the desired course of action. To prescribe the antibiotic it is necessary to invoke the prescription screen through the problem on the problem list. This is done by double-clicking on *Otitus Media* (to carry on with the example). The prescription screen opens and a reference to the condition appears at the top of the screen as a reminder of the reason for prescription item, see Figure 2. Now select and add the drug of choice using the *new drug* button and return to the *patient frontsheet*, see Figure 5. The process may be iterated with any number of problems on the problem list. Effectively, each time a healthcare professional prescribes *through* a reason for encounter on the *problem list* item a link is formed with the allotted drug. In this fashion, every single drug ever prescribed using this system is attributed with a single RCC code. The missing link has been found.

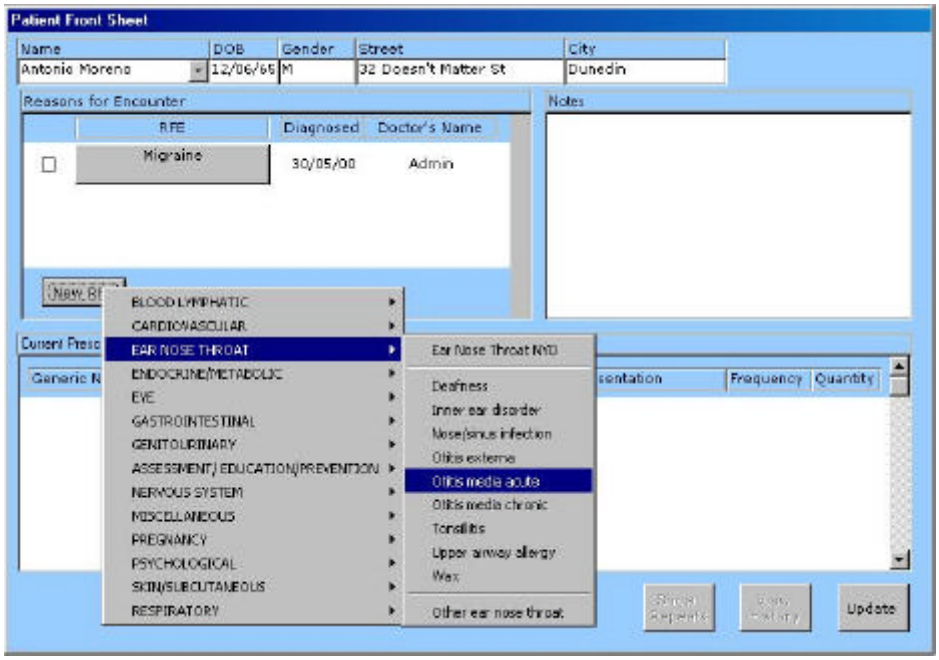

Figure 3: Using drop-down menu to add a diagnosis to problem list.

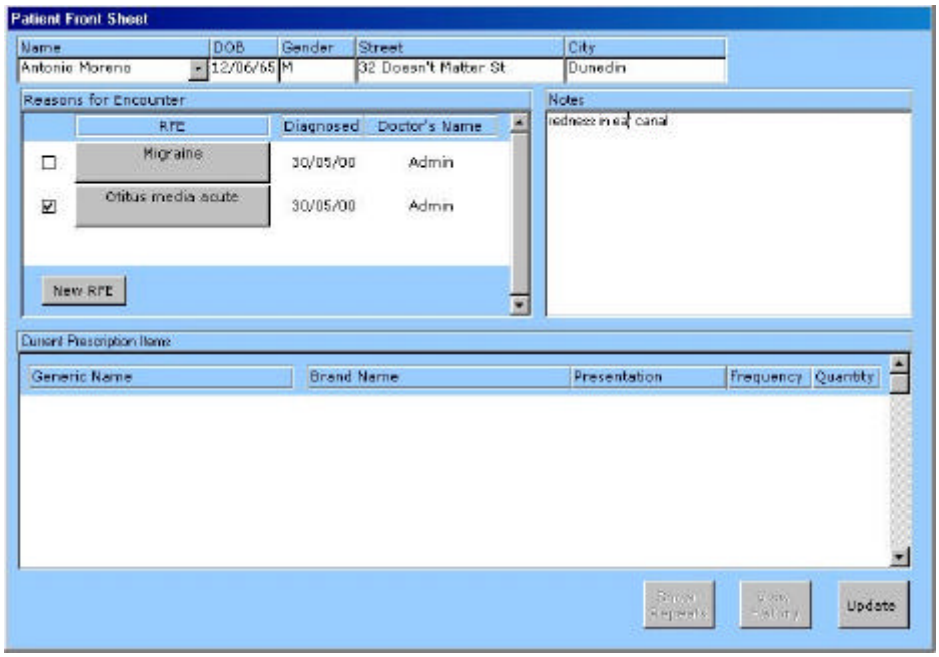

Figure 4: A diagnosis is added to the problem list and some notes are entered.

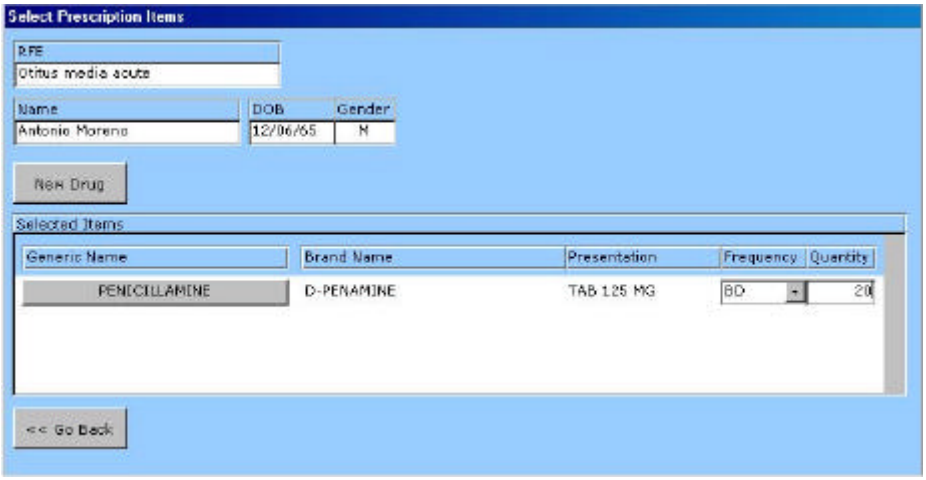

Figure 5: Drug added to prescription list (list of drugs not shown)

ENTITY RELATIONSHIP DIAGRAMS FOR CURRENT AND PROTOTYPE SYSTEMS

This paper now moves on to explain the differences in the data structure between current medical systems and the suggested prototype of this paper. It must be noted that these ERDs are simplified. In a commercial release of a medical system there would be many more tables, which support many of the functions that are omitted at this stage in the prototype for reasons of clarity in explaining the issues.

As stated earlier, in current systems there seems to be a *parallel linkage* relationship (Kennedy, 1996, Kennedy, 1993). The highlighted entities in Figure 6 show this relationship. This *parallel linkage* relationship has innate difficulties associated with it;

these are the fact that the two entities at the extremities of the linkage are inherently unrelated, and that processing is difficult because it requires the formation of a record complex. In the case of current medical systems, individual items and individual read codes from the same consultation cannot be related. See Figure 6 for a simplified and generalised ERD of implied in current systems.

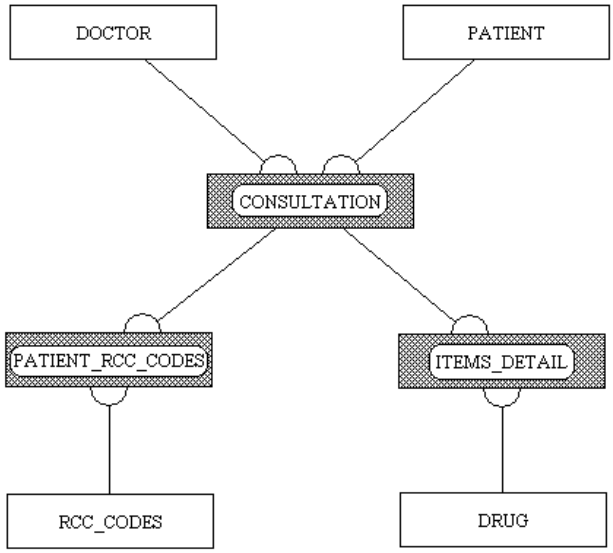

Figure 6: Simplified ERD of current medical information systems

The solution lies in making a RCC classification an attribute of the prescription item (ITEMS_DETAIL in Figure 6). This unfortunately leads to another problem in that the RCC can only be related to a consultation if a prescription is made. However, a doctor will often see a patient and not prescribe any drugs. This problem is overcome by adding an associative entity between PATIENT_RFE and CONSULTATION. Now it is possible to relate RCC codes to drugless consultations. With the patient's RCC codes now being a required attribute of ITEMS_DETAIL, every time a prescription item is entered into ITEMS_DETAIL, a patient's RCC code must also be entered for the transaction to complete. Therefore, in the application it is necessary to enter this RCC code related to drug either manually or automatically. Coupled with the interface changes mentioned above it is very easy to do this automatically by prescribing *through* the reason for encounter. Figure 7 illustrates the changes to the data structure to support queries more effectively. There is no way to avoid the relationship between associative entities suggested by consul_codes in Figure 7, this is because there are two distinct relationships between the patient’s reason for encounter and the consultation, one which involves a prescription and one which does not.

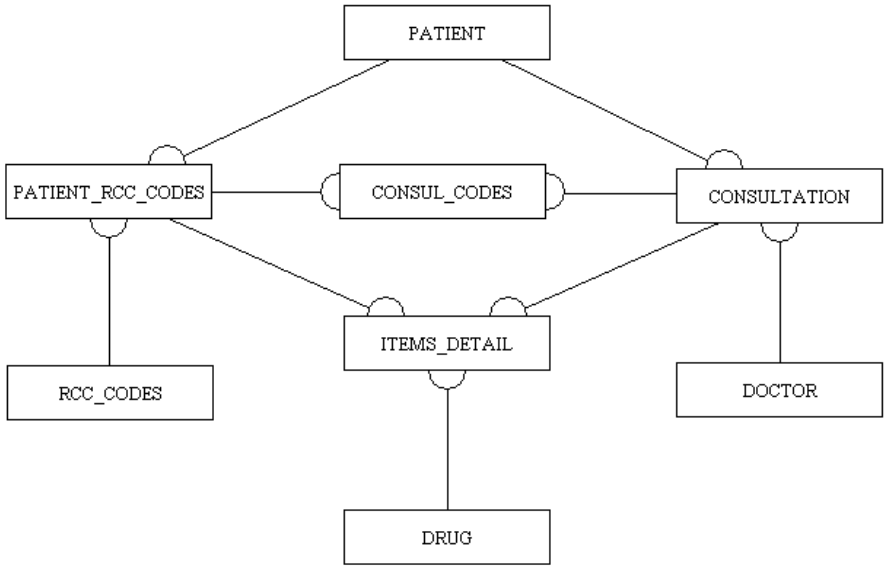

Figure 7: Simplified ERD of prototype

FURTHER WORK

It is proposed that a pilot study be carried out to elicit feedback from the medical community on the efficacy of the prototype. Since the prototype represents an amendment to specific functions within existing software, rather than a fully functional medical system in its own right, the features that it aims to replace will be identified for the evaluators. In addition the fact that the cut down list is customisable will be emphasised for participants.

Initially a sample of 20 GPs will be identified the prototype will then be distributed to them via the Internet or 3.5 inch floppy. The questionnaire will focus on two specific areas:

- Use of drop down menus; speed, efficiency
- The feasibility of adding a reason for encounter before prescribing (in order to establish the link between RFE and prescription)

If the use of the drop-down menus, which implement a reduced set of RCC codes and the new prescription process prove to be effective, further efforts will be needed for the actual implementation. This may involve seeking support from healthcare bodies such as Independent Practitioners Associations (IPA) and governmental agencies such as the New Zealand Health Information Service (NZHIS).

A further analysis of the extent of this particular data quality problem within electronic health records is desirable; the work presented here represents a case study of one particular health system within New Zealand. Wider investigation is warranted, specifically looking at other software both nationally and world wide to identify the extent of this problem and any proposed solutions.

CONCLUSION

This paper has described a significant data quality problem in the data that is exported from commonly used health information systems in New Zealand. The problem is significant because it limits the information that can be accessed by research organisations and ultimately government funding agencies. The solution lies in a small but fundamental change to the underlying data model and this is illustrated using the prototype described. Adoption of this change involves effecting buy in by key healthcare bodies. As a first step towards incorporation of these ideas into current medical software a pilot study is suggested.

REFERENCES

BPAC (2000) " Best Practice Advocacy Centre: The key to success in healthcare" http://www.southlink.co.nz/~bpac/, visited 10/08/00.

Britt, H (1998) Reliability of central coding of patient reasons for encounter in general practice using the International Classification of Primary Care *Journal of Informatics in Primary Care*, May, 3-7.

Cunningham, W. and Tilyard, M. (1999) Making Read Codes easy and useful in New Zealand general practice, New Zealand Family Physician, 26, 52-55.

Dovey, S. and Tilyard, M. (1996) The Computer Research Network of the Royal New Zealand College of General Practitioners: An Approach to General Practice Research in New Zealand, British Journal of General Practice, 46, 749--752.

George, S and Warren, J. (2000) Statistical modelling of general practice medicine for computer assisted data entry, *International Journal of Medical Informatics*, 57 77-89.

Kennedy, G. (1993) A systematic approach to the specification and evaluation of an information systems development methodology, PhD Thesis, Information Science, University of Otago, Dunedin.

Kennedy, G. (1996) Elementary structures in entity-relationship diagrams: a new metric for effort estimation, In Proceedings of Software Engineering: Education & Practice (SE:E&P'96), (Ed, Purvis) IEEE Computer Society Press, P. O. Box 3014, Los Alamitos, CA 90720-1264, USA., Dunedin.

Tilyard, M. and Dovey, S. (1999) The role of sentinel networks in general practice research in New Zealand and internationally, New Zealand Family Physician, 26, 48-51.

Tilyard, M., Dovey, S. and Simmers, D. (1994) Report to the Southern Regional Health Authority on Computerisation, University of Otago Press, New Zealand, Dunedin.

Tilyard, M., Munro, N., Walker, S. and Dovey S (1998) Creating a general practice national minimum data set: present possibility or future plan? New Zealand Medical Journal 111(1072):317-8.

ACKNOWLEDGEMENTS

Thanks for co-operation and feedback of the Royal New Zealand College of General Practitioners Computer Research Unit. Particular thanks go out to Gina Sayer, Isobel Martin, Trevor Walker and Wayne Cunningham.

COPYRIGHT