

Understanding GP Attitudes Towards A Data Amalgamating Health Informatics System

John Knight¹, Margaret Patrickson¹, Bruce Gurd¹ ¹International Graduate School of Business, University of South Australia, Adelaide, Australia

Abstract

This paper reports on the attitudes of 20 practitioners in South Australian General Practice towards adopting an unspecified data amalgamating Health Informatics (HI) system. Although aimed at improving the overall quality and management of healthcare, HI system adoption may require a change in the General Practitioner's (GP) approach to the way they perform their healthcare delivery role. This qualitative study found HI adoption was primarily influenced by the perceived potential for change in the professional's value and role. While GPs were generally reluctant to consider technological innovation that was not perceived to demonstrate potential for improvement in patient health outcomes, increased exposure to HI systems positively influenced perceptions of both the importance and the certainty of potential implementation outcomes. It was concluded that GP attitudes could be characterised by four different perspectives of HI systems use in general practice medicine delivery.

Keywords: Public Health Informatics, General Practitioners, Resistance, Adoption, Professional Role.

1. Introduction

This paper explores South Australian General Medical Practitioner (GP) reaction to an unspecified data amalgamating Health Informatics (HI) system. HI is an emergent interdisciplinary label for the 'application of computers to assist the gathering, storage, processing and use of information to improve the procedures or outcomes of health care...' [1]. Aimed at improving the efficiency and effectiveness of healthcare management, HI systems also include decision support and expert applications to potentially assist the medical practitioner in their tasks [2]. However findings indicate HI systems that can reproduce accepted models of clinical reasoning and can be viewed as providing immediate patient benefit have generally been adopted,

whereas systems aimed at improving the overall efficiency and effectiveness of healthcare appear to have been resisted [3-5]

Understanding why people accept (or not) innovation, particularly in information systems research, remains one of the most challenging and complex issues [6, 7]. Medical practitioners have often been cited as classic examples of 'professional' populations where understanding decisions of what innovations are adopted and when has been especially problematic [8, 9]. Whereas total government expenditure on healthcare delivery (9.8 percent of the Australian Gross Domestic Product in 2004-05) is projected to become unsustainable and unfundable over the next four decades without a change in approach toward health and aged care [10, 11], implementing HI systems is seen to

have the potential to reduce the cost of chronic care and significantly raise the overall level of public health [12, 13]. The need to identify factors affecting practitioner decision making is underscored by the rapid development of such systems, the push for adoption by governments and estimates that 76 percent of unintended events that could or did 'harm a patient' in Australian General Practice are preventable with such technology [14, 15].

Yet HI systems require adoption of electronic patient records and potentially the need to reengineer traditional workflows and disrupt existing business and clinical processes [16]. HealthConnect is an example of a national HI network initiative to routinely collect, store, exchange and download patient information at the point of care [17].

The electronic Journal of Health Informatics is an international journal committed to scholarly excellence and dedicated to the advancement of Health Informatics and information technology in healthcare. ISSN: 1446-4381

[©] Copyright of articles is retained by authors; originally published in the electronic Journal of Health Informatics (http://www.ejhi.net). This work is licensed under the Creative Commons Attribution-NonCommercial-ShareAlike 2.5 License (http://creativecommons.org/licenses/by-nc-sa/2.5/au).

Dependent on a proposed electronic patient record populated by sources across the continuum of healthcare, the majority of HealthConnect data was to come from General Practice [18]. Established with the support of all levels of government in 2005, the National e-Health Transition Authority (NeHTA) was tasked with setting the national standards for sharing health information [19]. Yet the results of the HealthConnect initiative remain a complex and multi-tiered collection of isolated programs and piecemeal projects [18, 20]. Estimated to see 85 percent of healthcare consumers annually, GPs nonetheless continue to be seen as gatekeepers to the wider health system and integral to delivering any comprehensive, coordinated and continuing healthcare strategy [21]. To facilitate such technology use, the Federal Government has targeted GPs with funding initiatives such as Practice Incentive Payments to increase the use of electronic prescribing [22]. Hence almost all practices nowadays have at least one computer, and some are seen to have increased the use of technologically supported systems and to have designed their processes in order to increase practice income [23, 24]. Yet a study between 2003 and 2005 found some Australian GPs who had access to computers and clinical software chose not to use them, and only a third kept all patient data in an electronic format [19]. The purpose of this study is to gather more detailed and in-depth information on why GPs tend to resist (or not) HI systems.

Studies of clinician behaviour suggest innovation is not necessarily always better, resistance always bad, nor adoption more worthy of study than resistance [8]. However understanding technology acceptance behaviour has largely drawn on application of research models such as Innovation Diffusion Theory or Behavioural Intention constructs (see for example [25, 26]). Innovation Diffusion Theory views innovation adoption as a process of reducing uncertainty about outcomes rather than as a single event, and studies of

the introduction and penetration of innovations in healthcare generally validate Rogers' S shaped curve of adoption over time (see for example [27]). On the other hand, Behavioural Intention models posit determinants of both intention to use technology and technology usage behaviour. This allows for perceptions of a behaviour to influence the level of effort and persistence exerted in pursuit of performing that behaviour, and behavioural scientists have agreed a commonality of factors that facilitate (or inhibit) intention translating into behaviour [28, 29]. Thus the perception of an innovation's relative technological advantage will not by itself guarantee widespread adoption [30].

However, traditional frameworks are not necessarily seen to reflect the reality of innovation adoption and diffusion, nor is rejection seen as simply the mirror image of adoption [31, 32]. Furthermore, earlier studies have tended to take place within large and complex organisations, whereas General Practice in South Australia mostly operates as solo practices, partnerships or incorporated bodies averaging 2.5 GPs each [22]. Behavioural intention studies in healthcare environments have also been criticised as lacking consistency with studies using non-professionals[33]. Similarly, there is little diffusion research that examines the impact of organisational context [34]. Limited relevant information systems research literature does attribute new technology resistance to technological, individual, organisational and external factors (see for example [35]). In particular, key inhibitors have been identified as uncertainty about future business models and perceptions of inadequate technical, legal and policy infrastructure[36].

It seems reasonable that technology adoption within General Practice may be influenced by structural and cultural complexities different even from other healthcare settings, and technology adoption models have arguably been generalised to a commonality of factors that lacks regard for contexts and settings [37, 38]. Also, previous technology acceptance research has only made limited use of the literature from professional groups. Yet early evidence suggests change perceived as an assault on a professional's autonomy (such as making their skills programmable) triggers resistance, as this not only impinges on their autonomy but also drives a change in the organisational form [9, 39]. These findings indicate technological innovations are likely to be resisted if the change process, change agent, risks or outcomes are perceived to be incompatible with the professional's values, goals, skills or ways of working [40, 41]. Thus even if the efficacy of the technological innovation is accepted, perceptions of anticipated implementation outcomes could still lead to resistance, rejection or non-adoption. This research explores the question:

What do practitioners in General Practice medicine perceive as barriers to implementing an unspecified Health Informatics system that can potentially routinely collect, analyse and redistribute information?

Drawing from the paradigms and the empirical studies cited above [8, 25, 26], the authors developed a model to frame the research (see Figure 1 below). The model illustrates the process by which theory suggests a GP develops a perception of the reladvantage of adopting a ative particular HI system. This can be seen as the emergent outcome of individual and environmental characteristics and a perceived potential for change if the innovation is adopted. The model posits that the perceived relative advantage, behavioural intention and subsequent behaviour of a GP contemplating adoption of a particular HI system within a particular context is influenced by individual perceptions of environmental antecedents and the professional value and role of GPs. There is a loop in Figure 1 for the perceived advantage leads to a decision to resist or not. Subsequently the outcomes of the decision confirm or disconfirm the decision and flows back to GP perceptions.



Figure 1: Research Model of Influences on GP Attitude towards a new Health Informatics System

2. Research Methodology

Interviews for this study were conducted between January and October 2007 with GPs in member practices of South Australian Divisions of General Practice. Practices varied in size (from solo to 22 full time equivalent GPs), structure (2 solo, 2 only partners, 14 partners and associates, and 2 incorporated) and designation (13 Metropolitan and 7 Rural). All of the member practices of three Divisions were offered the opportunity to participate in the study through initial communication with Practice Managers. Subsequently practices from other Divisions were involved and this paper reports on early analysis of interviews with 20 GPs (10 full time) between January and June. The GP's (16 Male) experience ranged from registrar to '25 plus' years, and qualifications ranged from an overseas trained Doctor awaiting Australian recognition to post graduate qualifications in such areas as Public Health, Obstetrics, Anaesthesiology and Doctorate of Philosophy.

In depth interviews lasting between 30 and 90 minutes were used to increase the likelihood of identifying the seemingly diverse yet interrelated communication, care, context and control causes for potential barriers to HI system adoption (see for example Conceptual Model [8]). The technology was described as able to record

patient data as an electronic record within the practice, but also able to potentially facilitate the routine exchange of data outside their organisational boundary. Questions began with GP reaction to the topic and subsequent questions were specifically designed to probe deeply held attitudinal information and associated underlying tacit or informal knowledge [42]. Although categories of questions had been formulated to identify issues potentially relevant to GP concerns, GP answers determined how further questions were asked. Hence rather than asking pre-formulated questions, a funnel sequence of questions was utilised to uncover information not as yet available from prior research [43]. In particular the questions focused on GP perceptions of a lack of clarity or flexibility regarding the system design and implementation process; the lack of 'readiness' of the practice to implement such technology; any external influence of clinical or non-clinical opinion leaders; and the potential for the technology to change the professional value, role and relationships, and encroach on professional autonomy of the GP. Whenever concern was expressed, follow up questions centred on what mechanisms the system would need to include to rebut GP concerns. Specific demographic

data were not collected to ensure participant confidentiality.

To ensure that the full range of potential beliefs was canvassed, seven practitioners perceived by other interviewees to belong to practices of substantially above or below average technology use were purposively added to the initial sample. Each interview was later transcribed, delivering transcripts of almost 23 hours of talk which served as the unit of analysis. The transcriptions were analysed by manual content coding followed by NVIVO (computerised text-based analysis) to arrive at the key concerns and themes expressed [44]. Analysis of the manual content coding was undertaken in three phases, with each phase informing the next. The first phase of analysis sought to identify recurrent issues that GPs raised as relevant to their attitude formation towards the implementation and adoption of this type of technology. The second phase of analysis sought to gain understanding of the nature of influence of individual issues on GP attitude. The third phase of analysis sought to identify common themes between GP perceptions of technology issues and how they were seen to influence GP attitude. The data was approached from a logic of discovery with no advance hypotheses or a priori categories [45].

3. Results

All practices used technology to some degree. Only one practice had no clinical software (and no computer on the GP's desk), no broadband connection and no electronic pathology result capability. All 19 with access used clinical software to some extent. such as for generating scripts or recording quantitative patient data, however 4 did not record clinical notes electronically. The (5) interviewees who did not regard themselves as organisational innovation decision makers tended to support existing technology strategies and expressed overall satisfaction with their current usage. Nonetheless, all interviewees were readily able to identify opportunities and weaknesses with aspects of organisational technology in use. Many attributed slow HI system take up rate to be in part the result of little available time for GPs to spend addressing 'nonmedical' issues. Recent graduates had been introduced to clinical software '...as part of our GP training by GPs associated with the RACGP [Royal Australian College of General Practitioners] or an RTO [Registered Training Organisation] who had used the software...', but not as part of their university medical training. Continuing GP education however, was generally focused on '...saving lives rather than learning about computer programmes...' The perceived need for electronic interaction with external entities varied with context. but all interviewees identified electronic interaction with specialists as an important driver. HI systems were generally recognised as an integral part of contemporary healthcare provision, however the lack of a public health management perspective was suggested by an attitude of '...no conceivable need for access to deidentified amalgamated data...'

Yet a desire to improve the holistic and longitudinal outcomes of patient healthcare was always expressed. There was little to no interest in potential usage of de-identified (not linked to a unique individual) and delinked (not linked to other data

such as demographic) amalgamated medical data as this was perceived to offer '...nothing more than Medicare data could...' However all interviewees, regardless of context, recognised potential benefits from being able to access consolidated longitudinal patient records, and to a lesser extent linked statistical data. But a diverse range of barriers was also perceived including conflicting perceptions of the need to standardise processes and share clinical notes, the potential for competitive disadvantage, the resolution of ethical moral and legal issues, the availability of appropriate technology and the motivations for political and policy decision making. A 'closed book' (where new patients are not automatically seen) practice was not unusual (7 interviewees operated like this in some form), and attracting numbers of patients was not generally perceived as a competitive issue. However concern was expressed for the loss of GPs (2 interviewees raised this) to other practices because the practice could '...only maintain revenue if the remaining GPs worked even longer and harder...' The only GP interviewed who had changed practices recently cited the nature of work as the main reason. A consistent theme was the nature of the work had greater appeal to the GP than effective organisational use of technology. This was seen to be maintainable because the organisations were structured in order to underpin the GP performing their role.

Of the (80) 'issues' identified from the ideas, concepts, perceptions or attitudes expressed by the GP in the first phase of analysis, common themes were categorised (in order of source frequency of coding) as 'Profession' (i.e. related to practicing medicine as a General Practitioner); 'Internal' (i.e. related to GP practice competitiveness, processes and personnel); 'External' (i.e. related to the policies and systems in environments beyond the GP's practice); 'Data' (i.e. related to the collection, use and control of data in GP medicine); and 'Patient' (i.e. related to the patient relationship with the GP, GP practice,

GP profession and Healthcare delivery system).

Arising from these 'issues', the key sources of 'influence' seen to stimulate or engender GP resistance towards an unspecified data amalgamating HI system in the second phase of analysis were associated with GP perceptions or attitudes toward unwanted functionality (don't want/ need) of Data, inadequate attributes (capability and receptivity) of the Practice, or undesirable impact on the (autonomy, status, control and workflow) GP's Role. These 'influences' were seen to be moderated or mediated by the GP's perception of the role of a GP. While text analysis identified issues seen to potentially contribute to GP perception of the relative advantage of such technology, the same GP could raise different concerns about the same issue from different perspectives. Emergent attitude towards the potential value of amalgamating longitudinal electronic Health Data for example, was seen in some measure to reflect GP attitude towards the technology utilised to facilitate such data. However, GP perceptions of potential data value were also seen to be influenced by different GP concerns regarding the generation and/or access to such data, and whether this was in the context of the GP Practice or not. So while the 'technological issues' raised by GPs made identification of potentially relevant themes and constructs of concern possible, it also made clear that issue, theme or construct was rarely an exclusively positive or negative influence on emergent GP attitude towards such technology. Nonetheless, of the 80 issues identified, 23 were found to be a mainly positive 'influence' on the GP sample's attitude. While the positive issues were mostly only marginally positive in terms of coding frequency, 40% of total 'influence' coding was seen to be positive.

The third phase of analysis identified change in the Socio-political, Healthcare Delivery System or Profession context was generally perceived as outside the immediate control of the GP, while the impact of such change to the GP Practice and/or the GP role was generally perceived to in some measure be within the GP's control. Similarly, the impact of change in the context of the GP Practice on the GP's role was generally perceived to be within the GP's control. Hence, perception of undesirable change to the GP practice and/or the GP role perceived to be beyond the GP's control can be seen as major inhibitor to the GP adopting a positive attitude towards that change. Similarly, technologically facilitated change to the GP practice and/or the GP role perceived as beyond the GP's control can be seen as major inhibitor to the GP adopting a positive attitude towards that technology. By inference, not adopting such technology would forestall such change. So even if the GP acknowledged the potential of the technology to improve patient outcomes it could still not be implemented, or implemented and not adopted.

4. Discussion

The results for this study may be limited because Practice Managers generally negotiated an interview with the GP and their choice was generally ascribed to the technology champion status of the GP within that practice. Also the results reflect the views of GPs from just 20 of 1785 practitioners from 700 practices in South Australia. The sample was initially voluntary (13) and subsequently more purposive (7) and does not necessarily reflect the profile of General Practitioners in Australia [46, 47]. For example, GPs in solo practice (10% in the sample compared to 13% nationally), female (20% c.f. 34.0%), full time (50% c.f. 63.3%) and non-metropolitan (35% c.f. 27.1%).

GP resistance towards an unspecified data amalgamating HI system can be seen as an emergent outcome of negative GP perceptions of the system's ability to provide only meaningful functional Data, to be readily assimilated by the practice and to produce only desirable outcomes for the GP's role in a particular context. The data were further analysed through NVIVO and four discrete GP attitudes towards new HI systems were able to be identified. The GP in some manner perceive their primary role to be best practice management of the quality of patient outcomes in terms of health and wellbeing. While this suggests a desire for ongoing access to validating information, the GP perceives their role (and hence need for data functionality or practice capability) from an individual, practice, profession or Healthcare delivery system perspective. Hence any manifestation of resistance to such technology can be similarly characterised. The GP attitudes are not mutually exclusive and are more appropriately seen as a series of developmental and co-existing perspectives influenced by the GPs' perception of their role and value, the GP's need for self-validation of existing processes, and the GP's exposure to utilising HI systems as part of their workflow. These attitudes are summarised in Table 1 and further discussed below.

4.1. Passive or Active Resistance

While billing was computerised, a sole GP with a 'loyal' patient base and an '...almost spiritual...' patient care philosophy for example, could identify no adequate incentive nor potential for improved patient outcomes from adopting clinical software. On the other hand, the change in clinical note taking and a reliance on technical support were seen as unacceptable impositions on the GP's ability to perform the GP's role. Nevertheless voice recognition software was being considered because it '...can potentially record my thoughts faster than I can write them...' Such software was not intended to be utilised in front of the patient and had been trialled in the past but found to be inadequate. This GP attitude was identified from a diverse range of technologically aware practices and GPs. A practice which perceived itself to be 'paperless' for example, did not utilise the

electronic appointment capability incorporated in the billing application because it was considered to be wanting in comparison to the traditional appointment book for each GP. Where clinical software was present this attitude manifested as clinical histories being recorded by hand and the electronic patient database being maintained only for specific reasons such as chronic disease management or script writing. GP attitude to the clinical history notes (c.f. summaries) was possessive with little or no desire to share these outside of the practice. This was seen to reflect perceptions of the potential nature of the amalgamated data. Resistance was expressed in terms of the inherent value and control of the data outside the organisational boundary, and trust in potential data collecting entities. This contributed to uncertainty about the potential to maintain patient-GP trust, and of ownership and responsibility for the subsequent amalgamated data. Despite general recognition and even advocacy for technology utilisation associated with this attitude, the utilisation of particular technologies was seen to be a process too far removed from the GP's 'style' of 'thinking', 'reflecting', 'observing' or 'recording.' The primary inhibitor to adoption was seen to be unwanted change in the GP's ways of working. In this instance it is argued the GP will adopt the technology only if there is perceived to be a clear and certain advantage to the GP performing their role. Hence improved patient outcomes (health and attitude) must be clearly perceived to outweigh the need for the GP to adapt to new ways of working.

4.2. A tool to support individual processes

A practice justified implementation of clinical software for example, on the basis this would improve revenue and reduce the costs of maintaining patient records. Yet while all GPs subsequently utilised electronic prescribing, some GPs (both decision making and non-decision making) actively and passively resisted full

Attitude	Passive or Active Resistance	A Tool to Support Individual Processes	A Tool to Integrate Current Processes	A Tool to Transform Processes
Manifests as:	Lack of technology or available technology not used	Available technology not used: Electronic and manual processes duplicated	Strategic acquisition of hardware and more integrative software	Practice active in activities external to the practice
Benefits perceived primarily in terms of:	Individual Patient Outcomes	Organisational Advantage	Organisational Capability	Organisational capability as part of a healthcare delivery system
Costs perceived primarily in terms of:	Changes in individual workflows	Financial Terms	Financial Terms	Financial Terms
Other Concerns in considering Relative Advantage	'unreimbursed' time commitment; patient expectations; patient trust;	Costs are perceived primarily in terms of the cost of changing organisational processes and not as changes to individual GP workflows or autonomy	Change in organisational ways of working by autonomous members; Migrating existing systems; System reliability and capability	Trust in other entities; paucity of sanctioned software; indifference of software vendors; onus to use in- house resources; unresolved, changing or ambiguous policy issues; 'top down' yet 'piecemeal' approach of government
Adoption if:	Improved patient outcomes (health and attitude) clearly perceived to outweigh the need for the GP to adapt to new ways of working	Clear and certain potential for organisational advantage	Improved individual workflow or organisational process (and hence patient outcomes) clearly perceived to outweigh financial costs	Facilitates the transforming of external entities and improves own organisational interoperability

 Table 1: Attitudes Adopted towards HI Systems by the Medical Professional in a General Practice Context

adoption of the application. A consistent outcome of this attitude was the need for a practice structure to be able to support both electronic and manual processes for the same task. In one practice this attitude manifested in patient files being physically transported between sites. The progressive implementation of different vendor systems also increased the likelihood of new software being perceived as less intuitive, and incompatibility between different operating systems leading to overall system instability. In this instance it is argued the GP perceives benefits of technology adoption as a clear and certain potential for organisational advantage. However fundamental to this attitude is costs are perceived primarily in terms of the cost of changing organisational processes and not as changes to individual GP workflows or autonomy.

4.3. A tool to integrate current processes

This attitude manifested to some degree in most practices as the strategic acquisition of hardware and systematic upgrading of clinical software and more integrative billing software. Also planned was integrating electronic readings (such as ECG) directly into patient files, and patient access to appointments through the internet. The adoption of more complex, less understood, less available and potentially more integrative systems was aligned with concerns about the need for change in the organisaof working tional ways hv autonomous members, migrating existing systems, and system reliability and capability. Those who had recently changed existing clinical software were generally looking to integrate billing and clinical software for 'greater system stability'. However this was also seen to create tension with GPs reluctant to consider changing vendors or existing ways of software use. Adopting this attitude was generally associated with GPs that had access to experience (both inside and outside the practice) of technology use in their environment and saw potential change in processes as acceptable outcomes of adoption. In this instance it is argued the GP primarily perceives benefits of technology adoption in terms of the potential for improvement in individual workflow or organisational process and hence for patient outcomes, and costs in financial terms.

4.4. A tool to transform processes

This attitude tended to manifest in practices with GPs active in medical activities outside of the practice, including professional organisations. Of those interviewees associated with scoping external projects, GPs identified the existing need for multiple activities to be duplicated in order to satisfy the requirements of all stakeholders involved in healthcare delivery. Concern was consistently expressed about trust in other entities, the paucity of sanctioned software

and apparent indifference of software vendors, and a perceived onus to use in-house resources to provide '...different solutions to the same problem...' Major inhibitors to adoption were perceptions of unresolved, changing or ambiguous policy issues (e.g. legal, ethical and data control) and in particular the 'top down' yet 'piecemeal' approach of governments to technological solutions. Examples cited included the government provider of electronic pathology results using a communication protocol different from that OACIS (Open Architecture Clinical Information System) uses to link public hospitals, and the non-standardised applications for communication with external entities (e.g. specialists, pathologists and Medicare). This attitude was generally associated with GPs that had access to detailed experience of technology use in similar environments and who perceived themselves or their organisation to be technologically capable. The potential to improve individual patient health outcomes through improved use of healthcare delivery system resources was the dominant driver. While change in individual workflow and/or organisational process was seen to be acceptable outcomes, change was primarily perceived in terms of the need to transform external entities. In this instance it is argued the GP is not only pursuing individual or organisational relative advantage, but is also adopting a less isolationist perspective of the quality and management of individual healthcare. However healthcare entity interoperability was also seen to be complex and difficult and to generate the least immediate concern for GPs in general.

4.5. Further Research

This paper reports on analysis of exploratory interviews with GPs conducted between January and October, 2007. This initial study seeks to gather and analyse qualitative data on what GPs perceive as the most important barriers to implementing data amalgamating HI systems to set the foundation for a more comprehensive and broader study in the future. Recurrent themes and concerns identified will be used to develop a 'concern' dictionary for a confirmatory survey which will explore strategies to reduce resistance.

5. Conclusion

All GPs interviewed represented their role as dispensers of complex health knowledge that was irreplaceable by technology or other disciplines in medicine. Inherent in this perception was a tension between efficiently and effectively (in terms of GP time and patient outcomes), and holisticallv managing а patient's longitudinal health. The majority of GP practitioners in the sample understood the relative advantage of implementing technological innovations in terms of financial and time cost, task performance, patient outcomes and organisational revenue. Yet GPs were in turn concerned about the potential negative impact of such technology on their role and value as a GP, and a number of participants strove to validate their reliance on existing processes. Despite consensus on the inevitable increase in such technology use to deliver healthcare in a General Practice context, any immediacy to implement technology was seen to be influenced by whether the GP adopted an individual, organior healthcare system sational perspective toward potential implementation outcomes. This was positively influenced by exposure to already existing HI systems as part of the GPs' current workflow.

Though this research did not seek to focus on adoption per se, an individual, organisational or healthcare system perspective of a potential for undesirable change in the GP value and role was seen to be the primary trigger for active or passive resistance adoption. Implementation of to incoming electronic pathology result applications meet little resistance from most (not all) GPs for example, because they are perceived to enhance data collection, value and use while facilitating the performance of the GP role. Yet outgoing data is perceived to facilitate a hitherto unseen transparency of the GP and their organisation's practices, and to need a certain (yet unclear) change to organisation processes, data nature and the GP's role and workflow. At the same time, GPs saw themselves as the primary system collector and repository of relevant patient data, and at the van of the healthcare system in clinical information technology use. This in and of itself amplifies any GP resistance because of a perception by GPs they will bear the greater (and unrecompensed) cost if such technology is implemented system-wide. On the other hand, the electronic sharing of linked (identifiable) data outside the practice boundary requires substantial change to the medico-legal and sociopolitical environments that is unlikely in the near term, and although essentially perceived to be beyond the GP's control, engenders little resistance 'in principle'.

Our data indicated that adoption would be facilitated if GPs were to be convinced that adoption had positive consequences that were closely aligned to improved patient outcomes, their own workflow would be improved, there was a clear and certain potential to advantage the practice and GP interaction with outside entities would be streamlined. Any resistance was seen to be exacerbated by low previous exposure to utilising HI systems as part of the GP's workflow. At the least this research provides a theoretical grounding for and empirical evidence of directions for future investigations of GP acceptance of technological innovations, and hence the development of counteracting strategies to overcome resistance and improve adoption in a particular context. We believe it will also contribute to existing understanding of why and how the medical professional forms an opinion about and the decision to implement (or not) innovations in a healthcare organisation context. The research may also have relevance to improving diffusion of other new technologies among other professional groups and contribute to mainstream change management lit-

erature with regard to why and how the professional forms an opinion about and the decision to implement (or not) innovations in different contexts and settings. The research may also benefit professionals themselves by allowing them to understand the barriers to technology adoption at different levels and settings of their organisation, and to understand that these barriers are not necessarily attributable to the technology. Finally, the findings highlight the desirability of ensuring the importance and certainty of potential HI system implementation outcomes are associated with benefits to the practice and the patient rather than burdens for the practitioner.

Acknowledgements

The authors would like to acknowledge the generosity of the General Practitioners and their organisations who took part in this research, and the Australian Research Council and the South Australian Divisions of General Practice for their support. The authors would also like to acknowledge the anonymous reviewers for their comments.

References

1. Sullivan F. What is health informatics? Journal of Health Services Research and Policy. 2001; 6(4): 251-4.

2. Jones R, Craig N. Patient information systems are not more expensive than leaflets. British Medical Journal. 2000; 320(7243): 1212.

3. Arroll B, Pandit S, Kerins D, Tracey J, Kerse N. Use of information sources among New Zealand family physicians with high access to computers. Journal of Family Practice. 2002; 51(8): 706.

4. Bolton P, Mira M, Kennedy P, Lahra MM. The quality of communication between hospitals and general practitioners: An assessment. Journal of Quality in Clinical Practice. 1998; 18(4): 241.

5. Walsh SH. The clinician's perspective on electronic health records and how they can affect patient care. British Medical Journal. 2004; 328(7449): 1184-7. 6. Frambach RT, Schillerwaett N. Organizational innovation adoption: A multilevel framework of determinants and opportunities for future research. Journal of Business Research. 2002; 55(2): 163-76.

7. Davis FD, Bagozzi RP, Warshaw PR. User acceptance of computer technology: A comparison of two theoretical models. Management Science. 1989; 35(8): 982-1003.

8. Greenhalgh T, Glenn R, McFarlane F, Bate P, Kyriakidou O. Diffusion of innovations in service organizations: Systematic review and recommendations. The Milbank Quarterly. 2004; 82(4): 581-629.

9. Mintzberg H. The structuring of organizations. New Jersey: Prentice-Hall; 1979.

10. Commonwealth of Australia. Intergenerational report 2002-03 Budget Paper No. 5 of the 2002-03 Budget 2002 Available from: http://www.budget. gov.au/2002-03/bp5/html/index.html.

11. Commonwealth of Australia. Health expenditure Australia 2004-05. Australian Institute of Health and Welfare (Health and welfare expenditure series No. 28) 2006 Available from: http://www.aihw.gov.au/publications/index.cfm/title/10350.

12. Kelly G. Electronics, clinicians, and the NHS. British Medical Journal. 2000; 321(7265): 846-7.

13. Warren JR, Noone JT, Smith BJ, Ruffin R, Frith P, Van der Zwaag BJ, Beliakov GV, Frankel HK, McElroy HJ. Automated attention flags in chronic disease care planning. Medical Journal of Australia. 2001; 175(6): 308-12.

14. Chau PYK, Hu PJ-H. Investigating healthcare professionals' decisions to accept telemedicine technology: An empirical test of competing theories. Information & Management. 2002; 39(4): 297-311.

15. Bhalsale A, Miller G, Reid S, Britt H. Analysing potential harm in Australian general practice: An incident-monitoring study. Medical Journal of Australia. 1999; 169(2): 73-6.

16. Ford EW, Menachemi N, Phillips MT. Predicting the adoption of electronic health records by physicians: When will health care be paperless? Journal of the American Medical Informatics Association. 2006; 13(1): 106-12.

17. Commonwealth of Australia. Health Online: A health information action plan for Australia. National Health Information Management Advisory Council 2001 Available from: http://www.health.gov.au/ internet/hconnect/publishing.nsf/content/ 7746b10691fa666cca257128007b7eaf/ \$file/actplan2.pdf.

18. Commonwealth of Australia. Lessons learned from the mediconnect field test and healthconnect trials (April, 2005). HealthConnect: e-Health Implementation Group 2005 Available from: http:// www.health.gov.au/internet/hconnect/ publishing.nsf/Content/key-reports.

19. Henderson J, Britt HC, Miller G. Extent and utilisation of computerisation in Australian general practice. Medical Journal of Australia. 2006; 185(2): 84-7.

20. Commonwealth of Australia. Managing change to avoid negative health and safety outcomes. ComCare 2004 Available from: http://www.comcare.gov.au/ pdf_files/PUB30_managing_change_Jan-04.pdf.

21. Weller D, Dunbar J. Chapter 1: History, policy and context. General Practice in Australia: 2004 2005 Available from: http://www.health.gov.au/internet/wcms/ publishing.nsf/Content/pcd-publicationsgpinoz2004.

22. AMWAC Report. The general practice workforce in Australia: Supply and requirements to 2013. Australian Medical Workforce Advisory Committee Report 2005.2 2005 Available from: http://www.healthworkforce.health.nsw.gov.au/ amwac/pdf/gp_2005.pdf.

23. Powell-Davies G, Fry D. Chapter 10: General practice in the health system. General Practice in Australia: 2004 2005 Available from: http://www.health.gov.au/ internet/wcms/publishing.nsf/Content/ pcd-publications-gpinoz2004.

24. Rudd C, Watts I. Chapter 9: The industry of general practice: Its infrastructure. General Practice in Australia: 2004 2005 Available from: http://www.health. gov.au/internet/wcms/publishing.nsf/ Content/pcd-publications-gpinoz2004.

25. Rogers EM. Diffusion of innovations. Fourth ed. New York: Free Press; 1995.

26. Venkatesh V, Morris MG, Davis GB, Davis FD. User acceptance of information technology: Toward a unified view. MIS Quarterly. 2003; 27(3): 425-78.

27. Gosling AS, Westbrook JI, Braithwaite J. Clinical team functioning and IT innovation: A study of the diffusion of a point-of-care Online evidence system. Journal of the American Medical Informatics Association. 2003; 10(3): 244-51.

28. Bandura A. Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice-Hall; 1986.

29. Fishbein M, Middlestadt S, Hitchcock PJ, Using information to change sexually transmitted disease-related behaviors: An analysis based on the theory of reasoned action. In: Wasserheit JN, Aral SO, Holmes KK, Eds. Research issues in human behavior and sexually transmitted diseases in the aids era. 1991; American Society for Micro-Biology: Washington, D.C.

30. Fitzgerald L, Ferlie E, Wood M, Hawkins C. Interlocking interactions, the diffusion of innovations in health care. Human Relations 2002; 55(12): 1429-49.

31. Gallivan MJ. Organizational adoption and assimilation of complex technological innovations: Development and application of a new framework. Data Base for Advances in Information Systems. 2001; 32 (3: Special Issue on Adoption, Diffusion and Infusion of IT): 51-85.

32. Gatignon H, Robertson TS. Technology diffusion: An empirical test of competitive effects. Journal of Marketing. 1989; 53(1): 35-49.

33. Chau PYK, Hu PJ. Examining a model of information technology acceptance by individual professionals: An exploratory study. Journal of Management Information Systems. 2002; 18(4): 191-229.

34. Larsen KRT. A taxonomy of antecedents of information systems success: Variable analysis studies. Journal of Management Information Systems. 2003; 20(2): 169-246.

35. Enns HG, Huff SL, Golden BR. How CIOs obtain peer commitment to strategic IS proposals: Barriers and facilitators. The Journal of Strategic Information Systems. 2001; 10(1): 3-14.

36. Debreceny R, Putterill M, Tung L-L, Gilbert AL. New tools for the determination of e-commerce inhibitors. Decision Support Systems. 2002; 34(2): 177-95.

37. Aarts J, Doorewaard H, Berg M. Understanding implementation: The case of a computerized physician order entry system in a large Dutch university medical center. Journal of the American Medical Informatics Association. 2004; 11(3): 207-16.

38. Kaplan B. Evaluating informatics applications-some alternative approaches:

Theory, social interactionism, and call for methodological pluralism. International Journal of Medical Informatics. 2001; 64(1): 39-56.

39. Swan JA, Newell S. The role of professional associations in technology diffusion. Organization Studies. 1996; 16(5): 847-74.

40. Bayless T. The preservation of good medicine is dependent on information. Journal of the Florida Medical Association. 1996; 83(9): 639-42.

41. Edwards N, Kornacki MJ, Silversin J. Unhappy doctors: What are the causes and what can be done? British Medical Journal. 2002; 324(7341): 835-8.

42. Sternberg R, Horvath J. Tacit knowledge in professional practice: Researcher and practitioner perspectives. Mahwah, N.J.: Lawrence Erlbaum Associates; 1999.

43. Cavana R, Delahaye B, Sekaran U. Applied business research. Brisbane: Wiley; 2001.

44. Bazeley P, Richards L. The NVIVO qualitative project book. London: Sage; 2000.

45. Strauss A, Corbin J. Basics of qualitative research: Techniques and procedures for developing grounded theory. Second ed. Thousand Oaks, California: SAGE; 1998.

46. Britt HC, Miller GC, Charles J, Pan Y, Valenti L, Henderson J, Bayram C, O'Halloran J, Knox S. General practice activity in Australia 2005-06. General Practice Series Number 19 (BEACH Bettering the Evaluation And Care of Health) 2007 Available from: http://www.aihw. gov.au/publications/index.cfm/title/10377.

47. Sims G, Bolton P. Chapter 3: The supply and distribution of general practitioners. General Practice in Australia: 2004 2005 Available from: http://www.health.gov.au/internet/wcms/pub-lishing.nsf/Content/pcd-publications-gpinoz2004.

Correspondence

John Knight

International Graduate School of Business Division of Business, University of South Australia City West Campus, 44-37 North Terrace Adelaide SA 5000, Australia

Phone: +61 (0)8 8302 9275 Fax: +61 (0)8 8302 0709

Email: John.Knight@unisa.edu.au