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Adverse Events in Hospitals: The Contribution of Poor Information Systems

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Abstract

Adverse events in hospitals, events in which harm results to a person receiving health care, are well documented (Wilson 1995, Hepler 2001). However, while factors such as lack of training and other human factors (Wilson et al, 1995) have been identified as contributing to this problem, there is a paucity of research attempting to link information systems failure to adverse patient events. This paper examines the co-occurrence of these issues.

Specifically, we look at two case studies relating to treatment decisions in two large public hospitals. We examine the incidence of adverse events in hospitals with regard to errors in treatment decisions where information delivery is unreliable. We ask the question: can information delivery problems lead to adverse events for patients?

It is important to empirically test the impact of this particular factor in the complex environment of hospitals where a full range of factors may adversely affect patient care.

We have reason to believe that poor information systems can have a negative impact on patient care leading to adverse events where data delivery and availability problems exist and are not being addressed by hospital management. Further findings of this paper are that I.S. improvements need to be complimented by cultural changes in hospitals that support the use of computerised systems, and enhanced approaches to I.S. governance in the context of healthcare.

Keywords: fragmentation, adverse events, IS governance, IS management

1 INTRODUCTION

Studies of adverse events in hospitals identify a number of contributing factors including communication problems, misread documentation, poor continuity and inadequate knowledge (Lombardi, 2001) without fully considering the role that Information Systems (I.S) can contribute to these issues. All of these factors could be addressed at least partially by better systems.

Sintcheko (2001) suggests that "many strategies for providing clinical decision support have failed because they have not provided timely and easy access to information that is current and relevant to specific clinical questions." Additionally, there has tended to be a low level of support in general for I.S. expenditure within the health industry (England, 2001) leaving information needs insufficiently addressed (Vincent, 1998). Research suggests that paper based information is inadequate in providing support for clinical decision making. " Textbooks, journals and other existing information tools are not adequate for answering the questions that arise : Textbooks are out of date , and the "signal to noise" ratio of journals is too low for them to be useful in daily practice (England, 2001)".

There is a cost in poor information flow and information management failure (Lederman and Parkes, 2002). Recent research has supported the suggestion that inadequate information management is one of the causes of poor treatment decisions in hospitals and leads to adverse consequences for patients . Wilson et al (1995) found that 16.6% of admissions to public hospitals result in an "adverse event" resulting in disability or a longer hospital stay for patients. 51% of the adverse events researched were considered preventable. Particularly noteworthy is the high number of adverse events associated with failures in record keeping, communication and information flow.

To a large extent these adverse events result from the massive volume of information generated in modern hospitals (Pereira et al, 2002). For example, in one of the hospital wards under examination in this research, an HIV ward, patients were likely to have had frequent episodes in hospital and have complex and changing drug regimes giving rise to substantial paper and computer based records at the hospital. Similarly, the second case study of a neurology ward found patients undergoing extensive testing regimes, PET scans, MRI scans, CT scans, blood testing etc with the various information items being delivered largely non-digitally from a number of sources both within and outside the hospital. All of this calls for high standards of information management and a significant commitment by hospital management to the implementation of effective systems. Recent evidence suggests that in many modern hospitals this commitment is not fully evidenced (Bates, 2001) leading to significant opportunities for errors, with the healthcare industry being slow to adopt technologies that would improve practice management (Goldberg & Wickramasinghe, 2003).

Additionally, information systems in hospitals are often controlled by disparate groups of doctors I.T. professionals and community members on voluntary boards often with competing objectives leading to serious governance issues (Rogers et al, 2003). Consequently, in this research we examine the connection between adverse events and poor systems management and specifically consider the extent to which such events may be associated with the failure to better manage hospital systems.

In this research we examine an aspect of the information system in two different wards in large public hospitals. In both cases we interview hospital staff and do a patient survey to examine a specific problem in relation to the delivery of patient information. In both cases we then attempt to measure the impact of the data loss that results from inadequate data delivery processes and finally consider the impact of this data loss on the ability of health care workers to administer adequate patient care and minimise adverse events.

2 CASE STUDY ONE

2.1 Background

The first case study took place in a large teaching hospital considered to provide a high standard of public care. The ward was dedicated to HIV positive patients who were often on a complex drug regimen partially implemented by the hospitals clinicians, but often commenced prior to admission. Data pertaining to drug treatment was often brought to the hospital by the patient or forwarded from a general practitioner. General information about the characteristics of drugs was available, potentially, either on-line or in hard copy.

2.2 Method

The methodology included both a set of interviews with hospital staff and a survey of patient drug interventions. These are instances when a patient's drug treatment needs to be changed to prevent an adverse drug reaction occurring or continuing.

The interviews provided grounds for the suggestion that information fragmentation as a result of stand-alone, non-networked systems may be contributing to prescribing errors and indicated the value of conducting some quantitative research to measure the problem more explicitly.

A patient data survey where the surveyor completed the survey with a pharmacist as s/he performed his/her job was undertaken to gather quantitative data indicating the extent to which common prescribing errors occur in the hospital under investigation. The sample size of the survey was 80 patient drug charts examined over a three-week period.

2.3 Results

The case study interviews identified a problem in the delivery of information in the prescribing process that seemed largely to stem from the non-integrated nature of the information system. While a number of useful computerised applications were available on the ward and contained all required data they were not linked in any way and the system was totally fragmented. In addition to this there was a lack of access to workstations, although staff felt that demand for workstations was in fact controlled by the fact that so much potential information was not available anyway on the non-networked system, so many staff did not attempt to utilise available workstations. There was in fact a culture of non-reliance on what were widely seen as inadequate system supports.

The interviews identified 9 different types of prescribing error summarized in Table 1 below, all of which have the potential to lead to an adverse event for the patient wrongly prescribed:

Drug contraindicated due to an interaction with a current disease. Drug contraindicated due to specific Patient attribute e.g Patient, gender, age
Inappropriate drug for clinical indication
Wrong dose of appropriate drug
Wrong drug spelling
Wrong frequency e.g daily not 3 times daily
Wrong duration
Drug contraindicated due to interaction with current drug
Wrong drugs initially- source of information faulty eg. GP letters, old hospital notes, a bag of medications.
Incorrect form of appropriate drug selected i.e oral vs intravenous vs subcutaneous

Table 1: Types of Prescribing Error

Despite the existence of information systems to support prescribing (see Discussion) the interviews indicated that sources of information from the "other"(eg. asking fellow staff, or using the paper-based MIMS drug index) category were often accessed as on-line information was either inaccessible or slow to access. This was problematic given that paper based sources were often out of date or difficult to locate and information taken directly from sick patients is not always a reliable source of information. Additionally, pharmacists were not always present on the ward or able to access information from their own memories or hard – copy sources.

The survey results quantified these problems as follows: of the 80 drug charts studied, 56 or 70% contained one of the errors on Table 1 above. The number of charts where the pharmacist felt an intervention was required to prevent an adverse drug event totalled 46 charts .The rate of acceptance of interventions for patients' drug charts is very high: 94.5% of these interventions were accepted by the relevant clinicians. In a survey done at the hospital on clinicians authorising changes to the patient's drug chart by the pharmacist it was found that in 86% of cases clinicians approved the changes recommended by the Pharmacist (internal document on Pharmacy Workload Indicators-available on request) in a much larger sample size. This indicated that the changes in the drug regimen suggested are genuinely necessary.

In the 46 cases where an intervention was required 38 were deemed to result from one of the following causes or combination of causes related to information systems failure listed in Table 2. Most common were problems stemming from the lack of availability of drug information (which should be available on-line) and the ability to access patient information gathered outside of the hospital or in other parts of the hospital:

Lack of access to patient information	4
Lack of access to drug/medication information	6
Lack of access to dosage information	12
Lack of access to alternative drug information	9
Lack of access to patient information and lack of access to drug/medication information	2
Lack of access to dosage information and lack of access to alternative drug information	3
Lack of access to patient information and lack of access to dosage information	1
Lack of access to drug/medication information and lack of access to dosage information	1

Table 2: Information Access Problems Identified by Hospital Staff

2.4 Discussion

In 38 of 80 drug reviews lack of information is given as a reason for a drug intervention being required. The interview data suggests that the cause of this lies in the inaccessibility of the on-line information and the lack of connectivity between applications rather than a lack of information per se.

Of the interventions that were effected by the pharmacist, the most frequent type of prescribing error that occurred involved the dosage of a medication for the patient (15/38). The relevant information about prescribing the appropriate dose for the patient is available to clinicians but this information is often not accessed or accessible at the time of prescribing. The sources of information that would indicate the correct dose are the on-line MIM's drug index and the paper-based form of the MIM's guidelines. In a study completed by a Hospital Medical Officer at the hospital under examination, in 51% of cases, pharmacists had difficulty accessing on-line MIMS due to lack of availability of computer work stations near the hospital locations where prescribing decisions were being made. This is clearly problematic as the interview data suggested that paper- based MIMS records are often out of date and not as extensive as the on-line version.

The results of the patient-data survey indicate that lack of access to alternative drug information contributes to 12/38 of interventions that are performed by the pharmacist. This is the second most frequent type of error that requires an intervention. The drug that is originally prescribed may be

technically correct and may treat the conditions for which it has been prescribed, but there may be an alternative drug that may target the condition more effectively given the patient's individual case.

The findings from the survey suggest that information about medication alternatives is available to the clinicians but, again, is difficult to access. Like dosage information, information about medication alternatives is available from sources such as the MIM's guidelines, on-line and paper-based, that are located on the ward. It seems from the survey that clinicians have difficulty accessing this information as errors are made as a result of this information being inaccessible- despite it being available in theory.

The results of the survey indicate that lack of information about the patient contributes to 6/38 of the prescription interventions. Information about the patient's previous prescribing history and the results from pathology and radiology tests are included in the paper based medical history and do not have information systems support at all in the ward under examination. With problems with record keeping being a major source of adverse events in hospitals in general (Wilson et al, 1995), clearly it is valid to consider how accessible information systems which allow patient drug histories to be easily viewed, would assist in minimising prescribing errors.

The results of the survey show that drug/medication information (e.g. information about interactions between drugs) contributes to 8/38 of the prescribing errors that were measured in the survey. Again, general information about issues such as possible interactions should be available through the on-line MIMS system but this is often difficult and slow to access and pharmacists instead rely on paper-based copies. Information regarding drug interactions is also another area where access to extra patient data from sources such as the patient's General Practitioner and previous institutions that the patient has been admitted to at the time of prescribing, would assist in reducing the amount of prescribing errors that occur.

The hospital clinician cannot access patient histories as the application that contains patient data does not contain previous drug histories and, in any case, is not readily available on the ward. To some extent this is not just a case of hospitals failing to invest in I.S make information available at locations where decisions are being made. There are also problems with protocols with regard to what information from outside sources is passed on that also prevent clinicians having full access to patient information. Hospitals are also wary of the legal implications of relying on information that they have not collected themselves. In the ward under examination, however, patients often have extensive drug histories developed on site. Nonetheless, as information from the different hospital wards and departments is not networked together, even where information is potentially available with no legal or privacy constraints, it is still not fully accessible as a result of poor systems management.

3 CASE STUDY TWO

3.1 Background

The second case study also takes place in a large public hospital, one of two major medical imaging centres in Australia. Like Case Study One, the system is fraught with examples where hospital staff are forced to make decisions about patient treatment without full information. Imaging modalities available at the hospital include X-Ray, Magnetic Resonance (MRI) and PET(SPECT). To date, the management of these image processes has been independent of automated hospital records keeping procedures and the distribution of image data to medical practitioners has been reliant on hard-copy rendering and manual file systems. It is a semi- automated process in the sense that the scans are digitised and stored on disk in digitised archives with the potential for networked electronic transmission, but, once removed from the imaging centres, are in fact transported manually around the hospital. The process under examination looks at a patient entering the hospital for treatment where consultant doctors will be using image based data in making a treatment decision.

3.2 Method

A series of interviews with hospital staff was initially conducted and indicated that the semi-automated nature of the process prevents information being available to consultants trying to make treatment decisions. While scans are taken in digitised form the scanners are not networked to the consulting rooms and the process for transferring them around the hospital is largely manual. Scans are generally stored in hard copy form with one copy being shared across the system by nurses, doctors, radiologists and any other professionals who may have an interest in a particular patient. While users are supposed to return all scans to the central file area, they do not always do this in a timely fashion, and, in fact, the unreliable nature of the system encourages people to hold on to patient data rather than returning it. This practise increases opportunities for data to be lost and for delays in data transfer to occur. As in Case One, a culture of system distrust has arisen, which in itself contributes to system problems.

Following the initial interviews, which uncovered the problems discussed above, a patient data survey was conducted to more rigorously measure the extent of the data loss problems. The survey examined the full impact on patient care and the likelihood of adverse events occurring when doctors do not have access to multiple images (eg PET and MRI simultaneously) when requested or, in many cases, do not have access to any data at all.

The patient data survey was used to monitor delays in the receipt of both single and multi-modal patient data sought by a consultant (doctor) for outpatient (mainly) consultations to model patient workflow. In this case, we define multi-modal data as more than one data type – e.g a PET scan plus an MRI scan. In general, the information flow for the process under study included a standard delivery time for data of seven days, around which consultation times in the workflow were organized. This seven day delivery process applied where a scan had been performed earlier and stored with seven days required to retrieve it from storage.

The patient data survey was designed with a number of aims in mind. If it was found in the consultant's response that some data was not available to the consultant then the patient data survey looked at the subsequent consultant behaviour and consultant's belief about the impact of the missing data (e.g. could a treatment decision be made without this data?).

In cases where the data was not available, the consultant was asked to indicate whether it was necessary to reschedule the consultation, possibly delaying treatment, and to consider whether or not the absence of the data effected the consultant's capacity to provide the most appropriate treatment.

3.3 Results

The results arising from data collected at 80 patient consultations were as follows:

- • In 76% of cases both of the data items that were sought were available within the benchmarked time (7 days).
- • In 23% of cases some or all of the data sought was missing and each set of data took between half an hour and fourteen days to find and between half an hour and one hour of the doctor's own time to find.
- •In 20% of these cases the patient was an in-patient. In these cases a treatment decision could not be made and the consultant felt that had the data been available he would have been able to make a treatment decision.
- •Of the outpatient cases where data was missing, in 37% of them it was necessary to reschedule the outpatient consultation.
- •In 87% of these cases it was felt that if the data was available it would have been easier to make a decision, but only in 37% of these cases was it possible to postpone making a decision.

3.4 Discussion

While, like Case 1, this is a small patient sample, other Neurology consultants interviewed from the same department as the parameters were drawn, validated the results recorded with the patient data survey and felt that they were able to be generalized across consultants. The results from the patient data survey signal the following problems in the current semi-automated information management process:

- There is evidence of treatment delay in a situation where data is delayed or goes missing. While deferring decision-making may often be a positive step where requested data is missing, it is still a step which necessarily lengthens the patient episode. It does this by causing the patient to revisit an earlier node in the treatment process by either having extra consultations with the doctor or having a repeat scan performed.
- Where it is not possible to delay decision-making, there is a possibility of a higher error for margin on decisions taken, and a possible adverse consequence for the patient.
- Consultants may sometimes request data that is not necessarily required for decision making to reduce the risk of not having the data *if* required. However, we can presume that consultants do not often frivolously request information that they do not think they will use. This is in consideration of the fact that image based data is expensive to collect and store and the procedures for extraction are often uncomfortable and unpleasant for patients. Where multi-modal data is sought, all parts of the data request are generally considered likely to be of some value in the patient treatment process. While doctors may be able to make valid and correct decisions in the absence of full information, on average, safer decisions with fewer margins for error may be possible the more that information that has been sought is made available.

In Case Study 2 the interviews and the patient data survey have illustrated the possible contribution of the semi-automated process in delaying data return. This can interrupt workflow where information flow and patient flow fail to intersect as planned, and, consequently impede both decision making with regard to patient care and patient throughput. This may impose a health cost on patients and effect the efficient use of both the human and technological resources available in the organisation. This is a vital issue for research where hospitals are investing millions of dollars in imaging technology and need to consider the impact of systems environments which do not support the distribution of the images that are produced. Under fully integrated systems which automate the delivery of data, in both in-patient and out-patient situations, total treatment times could possibly be reduced or contained if data was available when expected (or as needed in an on-line system). Instead, with a semi-automated system, treatment times are extended with possible health consequences as patients wait for appropriate treatments to be determined from the requested data.

Both case studies clearly indicate that there are problems in the efficient delivery of patient data even in large hospitals known both for their high standard of patient care and for their willingness to invest in expensive technology such as PET and MRI. Our observations suggest that even where there are systems to support the delivery of prescribing information and massive investment in scanning technology, information is still not getting to those people making treatment decisions when and where it is needed. Both our interviews and observations suggest that poor direction and lack of awareness by hospital management has stood in the way of better use of available systems.

4 CONCLUSION

There are issues for consideration in this research for any organisation that invests in techniques and technologies for the collection of data and then fails to distribute the data gathered in an effective and strategic manner. What is also apparent, and requires further research, is that technology may not fix all problems. In both cases, issues of organisational culture and poor I.S. governance may also contribute to the problems observed.

What is clear, however, in both cases, is that with improvements in technology infrastructure that allow patient and drug information to be delivered when and where it is needed, patient care may be enhanced and the likelihood of adverse events reduced. The contribution of this paper is this linking of adverse events and failures in data delivery and the quantification of the current data-delivery problems. This contribution will provide hospitals with important data for dealing with this complex problem. Certainly, when we look at the consequences which stem from information fragmentation, we see the value in hospitals considering taking advantage of available, fully-networked and integrated systems implementations or the lesser explored wireless solutions (Goldberg & Wickramasinghe 2003). These systems fully automate the delivery of data and allow much greater advantage to be gained from the patient data that has been collected. In order for this to happen, however, a serious commitment to enhanced IS governance is required, where all parties both understand the extent of the existing problems and are willing to commit the resources to dealing with them.

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