

## Supporting work practices, improving patient flow and monitoring performance using a clinical information management system

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### Abstract

Providing information technology solutions to clinicians to support their work practices benefits clinicians, administrators and patients. We present our 8-year experience with an inexpensive information management system which provides clinical and business process support for clinicians and bed managers. The system has been used by an area rehabilitation and aged care service to manage inpatient consultations and patient flow across nine hospitals. Performance monitoring of the time from referral to consultation, the number, type and outcome of consultations, and the time taken to access a rehabilitation or subacute bed is also provided. Read-only access to the system for clinicians and bed managers outside the rehabilitation and aged care service allows greater transparency.

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THIS CASE STUDY DESCRIBES the development and implementation of a clinical information management system across a network of hospitals in a New South Wales Area Health Service. The system is now being upgraded to meet the require-

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### What is known about the topic?

There have been few published evaluations of information technology (IT) system implementations in health care.

### What does this paper add?

This paper outlines the design and implementation of a clinical information management system for a New South Wales Area Health Service. The system enables clinicians to manage and track patient referral, consultation and transfer to rehabilitation and subacute beds. Its introduction resulted in decreased time to consultation and transfer.

### What are the implications for practitioners?

The authors suggest the success of the IT system was related to strong clinical leadership and effective user involvement in the design and implementation of the system.

ments of a new patient administration system (PAS) as well as to provide improved functionality and the potential for wider implementation across the now amalgamated Area Health Service. While originally designed to meet the needs of an area-wide Rehabilitation Aged and Extended Care Service (RAECS), this type of system has the potential to be used wherever a consultation service is offered.

The clinical information management system described in this case study has five key functions:

- Online referral from acute care or the community to the RAECS
- Online entry by medical staff of consultation details and outcome
- Effective bed management, especially when dealing with multiple sites
- Performance monitoring (eg, waiting times for consultation and transfer)
- An additional module that tracks patients waiting for aged care facility placement.

### **Brief literature review**

A literature review was conducted using Medline, Cinahl, Embase and PsychInfo, with the following search terms: information systems, clinician acceptance, bed management, patient flow, and performance monitoring. This revealed that there has been very little reported in the literature on the successful implementation of clinical information systems in Australia, despite the fact that their adoption is viewed as "mission critical" for health<sup>1</sup> and a cornerstone to enabling better health outcomes and high quality patient care.<sup>2</sup> While it is possible that local systems are in use, none were reported that addressed the key functions of the clinical information management system described in this paper.

A unifying theme in the international literature is that, despite the many advantages of clinical information systems, their adoption is not as widespread as expected.<sup>3-12</sup> In the United States, a snapshot of the extent of health care information technology adoption found that, despite growing interest in its use to improve safety and quality, adoption remained limited.<sup>3</sup> One system reported to have been successfully implemented is the Hartford Hospital in Connecticut's "Bed Management Dashboard".<sup>13</sup> This is a real-time process improvement and decision support product used by hospital administrators, clinicians and managers to streamline the process of admitting, transferring and discharging patients. It is reported to reduce emergency department overcrowding and improve patient flow, and is associated with increased physician and staff satisfaction.

In the United Kingdom, the National Programme for Information Technology of the National Health Service has specified a number of features designed to support patient flow, but reports of the successful implementation of systems to improve bed management remain scant.<sup>4</sup> One system, the "Bed Occupancy Management and Planning System", has been successfully used in a geriatric unit of a London teaching hospital to assist in making operational decisions about bed management.<sup>14</sup>

In Australia, Austin Health in Victoria describes the successful implementation of a bed manage-

ment system which colour codes patients according to their estimated date of discharge (the "Bed Manager's Traffic Light Model").<sup>15</sup>

### **Strategic and policy context in NSW and Australia**

Over the past 5 years, there has been considerable activity, both in Australia and internationally, aimed at the development of an electronic health record (EHR).<sup>16</sup> Nationally, the focus of the Clinical Information Project is on the clinical information content of shared EHRs.<sup>17</sup> Within NSW the Integrated Clinical Information Program defines the overall architecture and set of strategic initiatives to guide NSW Health's development of statewide clinical systems over the next 5-7 years.<sup>1</sup> The key objective of the architecture is to provide clinicians with a "single view" of the patient, facilitate clinical information sharing across settings, accelerate clinical decision making, and manage patient flow. Across the NSW Health system there is a new focus on information management and technology, which shifts the focus from technological capability to patient-centred care.<sup>2</sup>

### **Clinician acceptance and change management**

It is now accepted that the implementation of information systems is more a business than a technology issue,<sup>8</sup> and that major challenges to a system's success are often behavioural (people and organisational issues) rather than technical.<sup>9</sup> Benefits to the organisation must be clearly articulated and associated with business process change, not solely the implementation of technology. The two most important reasons reported for poor implementation are communication deficiencies (failure to prepare staff for the new system and ineffective communication) and inadequate leadership (failure to develop user ownership, and poor political skills in the leader).<sup>10</sup>

A set of 15 generic critical "failure" factors common to all information system developments has been proposed. Among these are the promise

of a leading-edge system, poor reporting structures, "fear-based" culture, poor consultation, poor training, inadequate testing and the system being seen as a "technology fix".<sup>9</sup> In the health care industry doctors have been typified as being slow adopters of information technology<sup>18</sup> who do not use the systems as well or as fully as they should.<sup>11</sup>

When implementing any system it is necessary to consider the user and the culture of the organisation to ensure that the system will be accepted by clinician users to be used fully.<sup>6</sup> A systematic review of computer-based patient record systems concluded that social, cultural and organisational factors are all important.<sup>12</sup> It has been suggested that the ultimate acceptance or rejection of a system depends to a large extent on its degree of usability.<sup>19</sup>

### **IT system development and implementation**

In 1996, the RAECS of a NSW Area Health Service managed four inpatient rehabilitation facilities, three of which were standalone. Overall, there were nine hospitals in the health service, with five providing acute care. Surveys of ward nursing staff, in the form of one day "snapshots" (but not using any formal utilisation review tool), conducted within three of the acute hospitals (including a major referral hospital), revealed that up to 23% of acute care hospital bed-days were perceived by nursing staff as being used inappropriately. From the response to the question, "If a nursing home or rehabilitation bed were available today, would the patient be discharged today?", it was determined that more than half of the acute care bed-days perceived to be inappropriate were for patients awaiting a nursing home or rehabilitation bed. The waiting time for access to a rehabilitation bed was reported to be in the order of 7 days, however there was no formal system of monitoring waiting times for either rehabilitation consultations or rehabilitation bed transfer.

Providing timely consultations across all of the acute care hospitals was a challenge, as was

reviewing patients already seen in consultation but not yet ready for rehabilitation transfer. This was because patients often moved between acute care hospitals as their acuity levels changed and there were seven rehabilitation consultants and four registrars involved in the provision of consultations, some of whom were part time. The RAECS received 1250 new acute referrals annually.

These challenges led the RAECS to investigate an IT solution, aiming to: more efficiently manage the inpatient consultation process; improve patient flow from acute care; and more effectively utilise the Service's rehabilitation bed base. This led to a two-staged process that firstly re-engineered the system for the provision of rehabilitation consultations and bed management, and secondly, that addressed the issue of the assessment and management of patients in acute care in need of nursing home assessment and placement (not described in this paper).

### **Consultation process and system development**

The first step in the process was to consult with the stakeholders, both internal and external to the Service. They included medical officers, key nursing personnel, bed managers and ward administrative staff. During the first 6 months of 1997 a paper-based system to centrally register referrals for consultation was developed and rehabilitation beds in the health service were managed as one bed base. The paper-based system provided an improved approach to bed management, but for it to work efficiently an information technology backbone was deemed necessary to support the business processes adopted.

Over the ensuing 6 months consultation occurred with the Information Services Department (ISD) and a detailed scoping study was undertaken in-house. The system chosen was a Vax-based program, also developed in-house. At the time the Vax offered the functionality required at relatively small cost (estimated to be \$30 000) and had a number of advantages: any networked PC or terminal within the Health Service would be able to access the system; real time access to information

already contained in the PAS would be available, thereby minimising data entry and allowing patient movements to be tracked; and benchmarking data could be collected automatically. Following consultation with stakeholders over specifications, a trial version of the system was developed, with the final version in place by the end of 1997. Training sessions for staff were held and user guidelines were written. External customers were provided with read-only access to the system.

### **Key system features**

The key features of the system include:

- Acute care ward staff can make referrals for a rehabilitation medical consultation by knowing only the patient's name or medical record number (this being common to all hospital facilities in the Area). Referrals are phoned through to a central number in the RA ECS and entered onto the system by administrative staff.
- Rehabilitation medical consultants and registrars then view (or print) all referrals, knowing the date of referral and location of the patient by hospital and ward.
- After the patient is seen in consultation, the RA ECS medical staff member completes the standard "Medical Consultation" form, which remains in the patient's medical record, and also completes the "consultation outcome" section of the IT system. This captures the date the patient is seen (defaulting to the present date), the SNAP (subacute and non-acute patient) rehabilitation impairment code and the outcome of the consultation (ie, whether the patient is accepted for rehabilitation or requires review). If accepted, the following is completed: the date the patient is estimated to be ready for transfer; the preferred rehabilitation facility; and brief nursing details.
- Patient lists within the IT system show the status of all referrals ("new", "awaiting review", "awaiting a rehabilitation bed"). This means that patients are not lost to follow-up, even if they change hospital or ward.
- There is also a facility to log rehabilitation bed requests for patients from outside hospitals and from the community.

- Once accepted for rehabilitation, bed managers use the system to prioritise transfers, by considering the preferred rehabilitation location and matching the services available at the rehabilitation facility to the patient's needs, including nursing needs. The ability to view demand for rehabilitation beds across all rehabilitation facilities allows bed managers the flexibility to even out demand across sites.
- Performance data are automatically collected, with the key data being the time from inpatient referral to consultation and the time from when the patient is ready for rehabilitation transfer until they are transferred.
- The system allows "read-only" access for acute care clinical staff, so that they can verify the status of the referral and consultation outcome. In situations of high bed pressure within acute care it is possible to identify patients who could have an earlier transferred arranged if appropriate.

### **Outcomes**

#### ***Outcome of the initial implementation***

Following implementation of the system in 1998, there was an immediate impact in reducing both the time to rehabilitation consultation and the time to transfer. Data from January 1998 until December 1999 showed that, in the northern part of the Health Service (containing three acute care hospitals) there were 2514 rehabilitation medical consultations, with an average wait for consultation of 0.83 working days. Eighty-two per cent of patients were seen within 2 days of referral. For the same period, the average wait for transfer to a rehabilitation bed was 1.2 days.

#### ***Recent outcomes***

Since implementation, the system has continued to be used with only minor modifications. No duplicate paper-based system has been required to manage consultation or bed management processes. Performance data are reported monthly. Data for the 2 years to June 2006 are shown in Box 1 and Box 2, broken down by the four acute care hospitals in the Health Service (the fifth

**1 Wait for rehabilitation consultation (July 2004–June 2006)**

Acute care hospital	Total consultations	Patients seen within 1 weekday, no. (%)	Patients seen within 2 weekdays, no. (%)	Average wait (weekdays)
Hospital 1	435	364 (79.5)	407 (93.6)	0.91
Hospital 2	284	176 (62.0)	240 (84.5)	1.42
Hospital 3	868	814 (93.8)	852 (98.3)	0.39
Hospital 4	2194	1757 (80.1)	2040 (93.0)	0.81
Total	3780	3039 (81.8)	3539 (93.6)	

**2 Wait for rehabilitation transfer (July 2004–June 2006)**

Acute care hospital	Total transfers	Patients transferred within 1 day, no. (%)	Patients transferred within 2 days, no. (%)	Average wait (days)
Hospital 1	205	114 (55.6)	139 (67.8)	2.47
Hospital 2	82	40 (48.8)	50 (61.0)	3.4
Hospital 3	297	201 (67.7)	227 (76.4)	1.56
Hospital 4	1245	879 (70.6)	992 (79.7)	1.46
Total	1829	1234 (67.5)	1408 (77.0)	

hospital is a small rural hospital and numbers are small).

Box 1 shows the average weekday wait for rehabilitation consultation for each hospital over the 2-year period, along with the total number of consultations per hospital for that period and the percentage of patients seen within and 1 and 2 weekdays. Overall, 81.8% of consultations were seen within 1 weekday, and 93.6% were seen within 2 weekdays of referral. There was an average of 36 new referrals per week across the four hospitals.

Box 2 shows the average number of days for rehabilitation transfer to occur for each hospital over the 2-year period, along with the total number of transfers per hospital for that period and the percentage of patients transferred within 1 and 2 days. Overall, 67.5% of patients were transferred within 1 day of being deemed ready, and 77% were transferred within 2 days.

**Upgrading of the system in 2006**

In 2006, funding was received to upgrade the existing system to meet compatibility require-

ments for a new PAS. This has also allowed the opportunity to improve the system's functionality and usability and add additional features. The enhancements to the system were driven by the clinician users. The upgraded system will have:

- Two modes of referral supported (fully online and via a central phone number);
- A redesigned referral screen to improve the appropriateness of rehabilitation referrals, by providing a structured referral entry process;
- The provision of additional clinical information within the online consultation form. When printed for the medical record, the standard paper-based medical consultation form will not be required;
- Hand-held computer capability;
- The ability to compare the "expected date of discharge" from acute care (a component of the new PAS) with the rehabilitation doctor's judgement of the estimated date that the patient is ready for rehabilitation transfer;
- Improved performance reporting, including the delineation of calendar and working days for benchmarking purposes, and graphically presented reports;



- An ability to prioritise transfer requests; and
- The addition of a "billing" function to track consultations on billable patients.

## Discussion

We view the implementation of this clinical information system as being successful on a number of grounds. It has stood the test of time, having been in place for 8 years.

When examining the reasons for the system's success we propose that the following factors have been instrumental:

- Users were involved in all stages of development of the specifications and testing of the system. User input resulted in a "keep it simple" approach with minimal data entry.
- There was close cooperation with the ISD, resulting in software that was simple and easy to use.
- The real-time nature of the system, lack of any need to duplicate data entry for information already captured by other hospital systems, and its ability to be accessed using any networked PC, enhanced usability.
- The system made sense in terms of the clinician's practice and workflow, and eliminated the use of any form of paper-based record since its inception. Some clinicians expressed concern about their lack of typing skills, but the minimal data entry requirements helped to overcome this barrier.
- Although the system enables administrators to report on individual clinician performance, it has not been used for that purpose. The culture of cooperation in the rehabilitation service mitigates clinician's fears of blaming and monitoring of individual clinicians. In addition, "performance reports" were designed that were not clinician specific.
- The RAECS had strong clinical leadership, with the Director also being responsible for all operational aspects and budget of the Service. This allowed the Director the ability to act with reasonable autonomy and to develop strong relationships with the ISD.

In upgrading the system to one with enhanced functionality, at the expense of added complexity, the challenge will be to ensure that acceptance and use are maintained. The prospect of rolling the system out to other rehabilitation services within the amalgamated Area Health Service will also provide a measure of the system's transferable qualities.

## Competing interests

The authors declare that they have no competing interests.

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