Improving health and public safety through knowledge management

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Summary: This paper reports on KM in public healthcare and public safety. It reflects the experiences of the author as a CIO (Chief Information Officer) in both industries in Australia and New Zealand. There are commonalities in goals and challenges in KM in both industries. In the case of public safety a goal of modern policing theory is to move more towards intelligence-driven practice. That means interventions based upon research and analysis of information. In healthcare the goals include investment in capacity based upon knowledge of healthcare needs, evidence-based service planning and care delivery, capture of information and provision of knowledge at the point-of-care and evaluation of outcomes.
The issue of knowledge management is explored from the perspectives of the user of information and from the discipline of Information Technology and its application to healthcare and public safety. Case studies are discussed to illustrate knowledge management and limiting or enabling factors. These factors include strategy, architecture, standards, feed-back loops, training, quality processes, and social factors such as expectations, ownership of systems and politics.

Keywords: knowledge management, healthcare, public safety, information technology

Knowledge management (KM) is a systematic process of identifying, capturing, and transferring intellectual assets for the benefit of organisations, their clients and staff[1]. This paper reports on the application of Knowledge Management in two industries: healthcare and public safety; which in the Australian context are primarily government-funded public services. The paper explores commonalities of issues, approaches and benefits.

Knowledge management in healthcare is addressed first as it is considered by the author to be more challenging and complex. The public safety case study of New Zealand Police is provided as a contrast as it is considered to demonstrate an approach may offer a model for healthcare.

Knowledge management in Healthcare

The history of information management in healthcare is patchy at best. Some areas such as laboratories were early entrants into automated processes and have made great use of technology including computer-aided diagnostics, robotics, records management, and

[1] American Productivity and Quality Center, www.apqc.org/km.

electronic communication of orders and results. Other areas such as imaging and gene sequencing are heavy users of, and critically dependent upon, high performance computing. For most of healthcare there is a low level of use of IT, a low level of integration of information between primary and secondary care, most intra-entity and inter-entity transactions remain paper-based, many mission-critical core systems are decades old, there is a low level of quality and comprehensive information at the point of care and data is incomplete for measuring outcomes and population health gain. There however are some exciting initiatives to address these short-comings.

Management of knowledge is essential for effectiveness as it is the key for health-care needs assessment, service planning, integrated care planning, disease management, delivery of care and evaluation of delivery and outcomes. While the cost of ICT investments is often a barrier there are opportunity costs of poor quality information, often seen in inefficiencies and adverse patient events. Poor data capture, data entry errors, poor maintenance of the currency or records and ineffective sharing are also costly overheads. These require investments in information integration, data purification and matching of duplicate records. Without a knowledge-driven approach care may not be targeted towards needs, interventions may not be selected on the basis of research evidence of effectiveness and outcomes may not be evaluated to inform future investment of resources and selection of interventions.

It is now several decades since the widespread adoption of computers into business. A popular model all those years ago was that the typical system would last for about seven years and then be totally replaced. It did not always work out that way and many industries have both software and databases that go back for several decades. Much of the healthcare industry has patchy and incomplete systems to meet business needs. The vision for a fully integrated modularised system to meet all of an organisation's business needs never fully materialised and most organisations now have a myriad of systems for specific business unit needs purchased from various suppliers. There are databases that duplicate data held elsewhere in our organisations, we have overlaid our so-called legacy systems with a layer of complicated reporting systems and have added data warehousing with complex links to other databases. As business needs have changed the systems and data repositories have been stretched and contorted to do things that were never imagined at the time of their design.

For most of healthcare there is a relatively low level of use of IT, a low level of integration of information between primary and secondary care, most intra-entity and inter-entity transactions remain paper-based, components of a patient's health record are dispersed across the record systems of the multiple providers that a patient may have consulted over time, many mission-critical core systems are decades old, there is a low level of quality and comprehensive information at the point of care and data is incomplete for measuring outcomes and population health gain. There is however a new wave of national, state and local initiatives to address these short-comings.

Customer relationship and e-commerce

A stimulus to investment in information systems has been the advent of e-commerce involving on-line trading and on-line relationship management which has been embraced by industries and sectors around the world and is already changing the nature of business activity and customer service. Healthcare is one of the largest single items of national expenditure in most developed countries including Australia, yet this sector is lagging in its application of ICT, e-commerce or KM. That is, the use of the Internet, intranets or extranets for on-line

transaction, interaction with knowledge-bases, and integrated customer service delivery. ICT and KM offer significant benefits to patients and carers, improvements in healthcare planning and resource management, and both clinical benefits and financial savings through electronic transactions and better information management

Industry has discovered a new focus for customer relationship management and CRM (Customer Relationship Management) systems and call-centre technologies are available on the market. These products enable a business to have a more intimate relationship with customers to address their individual needs through managing knowledge. Call centre operators know more about you when you call, can remember your details/preferences and the operator you deal with can solve most of your problems while you are on the line. While there have been significant improvements in health as with most other services, there is still some way to go.

Populations are often highly mobile. People do not always to the same doctor or clinic. There is currently little sharing of patient information between doctors even if they work in the same practice. Laboratory results that one doctor or clinic requested are not always available to the next doctor or clinic, similarly with radiology images and reports. Patients are not necessarily the best source of information about out their care history.

Healthcare is characterised by fragmentation. In Australia almost all layers of government are involved as well as the private sector. Many of the participating entities enjoy business autonomy in the case of doctor or clinics, retail pharmacies, private laboratories, and specialists or semi-autonomy in the case of large teaching hospitals. There is significant interest in a strategy for EHR (Electronic Health Record), at both federal and state health levels that will need to win the co-operation of multiple public and private entities for success.

Knowledge management for needs analysis

The challenge for planners is to obtain the greatest population health improvement for the available resources. Populations are never homogenous. It is important to know where the risk areas are, geographically as well as by social strata. A knowledge-base should advise on where needs are and consequently on the desirable locations for services to be provided. It should advise of the concentrations of the elderly or people with disabilities, the ability of people to travel to care and an understanding of what a reasonable distance might be. It should assist to identify, for example, the groups most likely to engage in unsafe behaviour and needs for education on nutrition. The population knowledge base would advise planners on what services need to be targeted where.

In an ideal world planners and policy-makers would draw from a knowledge-base to identify at-risk groups, those with a low health status or other factors indicating the need for healthcare intervention. The knowledge-base would inform the selection of intervention based upon research evidence or international best-practice. At the point of care, effectiveness would be optimised by the clinician having readily available all relevant information including the patient's history and the research evidence and best-practice guidelines. Evaluation would inform whether the intervention was effective both for the condition as well as for the target-group health status and whether different action was appropriate.

Knowledge management for care planning

A second challenge is the issue of the level of healthcare interventions that are supported by research evidence. There are various estimates of this and most are surprisingly low. Consequently there needs to be a mechanism to link the world's most up-to-date research and models of best practice with planners and clinicians. There is also the need to complete the loop and ensure all interventions are evaluated. Otherwise we cannot be sure we are not repeating habitual practice that may be ineffective or even damaging. A database that allows care delivery to be evaluated by outcome is essential.

Evidence-based care

Evidence-based medicine is the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients. The practice of evidence-based medicine means integrating individual clinical expertise with the best available external clinical evidence from systematic research. Individual clinical expertise is the proficiency and judgement acquired through experience. Increased expertise is reflected in many ways, but especially in more effective and efficient diagnosis and in the more thoughtful identification and compassionate use of individual patients' predicaments, rights, and preferences in making clinical decisions about their care. Best available external clinical evidence is from patient centred clinical research into the accuracy and precision of diagnostic tests (including the clinical examination), the power of prognostic markers, and the efficacy and safety of therapeutic, rehabilitative, and preventive regimens. External clinical evidence both invalidates previously accepted diagnostic tests and treatments and replaces them with new ones that are more powerful, more accurate, more efficacious, and safer.

Doctors are encouraged to use both individual clinical expertise and the best available external evidence. There is evidence of striking variations in the rates with which clinicians provide interventions to their patients as well as the type of intervention for a particular condition. Clinicians struggle to keep up with all the medical advances reported in journals.

A criticism of the evidence-based approach is that it results in slavish, cook-book approaches to individual patient care and cost-cutting. A search of "evidence-based care" in the internet will reveal a variety of opinions. It has also been associated with the health reforms in several countries and the HMOs (Health Maintenance Organisations) in the USA which are often regarded with suspicion by clinicians. Despite its ancient origins, evidence-based medicine remains a relatively young discipline whose positive impacts are just beginning to be validated, and it will continue to evolve.

Knowledge management for care delivery

Computer systems have generally been designed on a presumption that we are all desk-based workers. A barrier to adoption of information systems is that in many cases they add work for busy clinicians. In a hospital clinicians move from bed to bed, ward to ward, clinic or theatre and even between different campuses. To expect a busy clinician working long hours to add to this the time required to log in and interact with a computer at the beginning and end of round, let alone in between patients, is a big ask. The quality of data entered in a system is also related to the integration of the system into work practices. The quality of data entered at the point of care is likely to be greater than that which is entered after the event. At the time of giving care the information available from a system is likely to have greatest value and any data entered may be more complete and accurate than that which has to be recalled from memory or paper-based notes afterwards.

Instead systems need to be designed to meet the mobile work practices of clinicians. Bedside terminals, units that live on mobile trolleys and the like are expensive and have been disappointing in their adoption. Wireless LANs, linked PDAs and WAP-enabled hand-held devices offer promise to overcome a fundamental problem of the physical user interface.

Even if we solve the problem of a user-friendly mobile device, there is still the issue of data presentation. While much of the world's health research is available across the internet, with the average consultation lasting only a short time, clinicians are unlikely to have the time required to search for this information. Instead, like CRM systems that get to know consumers and tailor the delivery of information and offers to them, health systems need to get to know their users and individually tailor the information presented.

Challenges for KM in healthcare

In healthcare there is a strong culture amongst some of the professions that exults individualism. While nursing has been practicing KM for decades in the form of standard procedures in training and in policy, in medicine there is a strong culture that respects individual approaches. Consequently surgeons may take pride in the own individual approaches and would maintain that prescriptive or "cook-book" medicine is not in the patient's interests. Patients are unique individuals and a therapy that might be successful in one person may not be effective in another with the same condition. There is a tension between some medical practitioners advocates of evidence-based treatment.

A challenge is that KM projects can require already busy people to learn new systems and new ways of doing business which can be frustrating. In emotionally-charged environments the IT project can be a trigger for an outpouring of built-up resentments about unrelated issues. Yet the adoption and sense of ownership of new ways of doing things by users is critical for project success and for the quality of the data in systems.

KM needs to be balanced with concerns about privacy and discomfort with population databases. There are special issues about sharing information concerning the mentally ill. There are also occasions when people choose for reasons of embarrassment to see someone other than their regular doctor. Implementation of any of this needs to be in a manner that ensures patients are informed, feel in control of their information and who sees it.

KM would facilitate more rapid transfer of data, such as laboratory results, doctor or clinic records and hospital records, between health professionals. This should assist in speeding up the delivery of appropriate medical interventions and so aid in more effective and rapid recovery. Confidentiality and privacy need to be assured, as high security means that only fully identified and authorised users can access information. A by-product would include reduced lost or missing paper work, a complete audit trail of all electronic documents and information databases of community health status, risk factors, treatment best-practice and information on outcomes and the effectiveness of healthcare interventions.

KM can be expected to ultimately deliver patient benefits like earlier illness intervention, and reduction in conditions becoming acute. Doctor or clinics will receive electronic notification of patient discharges, online patient referrals and allow them to view the status of their hospitalised patients. Clinicians will have services like laboratory results arrive automatically with alerts about abnormal results so that they can recall the patient. Added value services may include links to intelligent data-warehouses, knowledge-based systems that can assist in diagnosis and treatment protocols. KM would also allow patients to be better

informed about their conditions and to be more actively involved in management of their own conditions.

There is a range of technologies that are or will impact healthcare information. These include data-warehousing and reporting tools, smart cards, self-diagnosis technologies, technologies to allow more services to be provided in primary care rather than the more expensive secondary care environment, e-libraries allowing rapid access and cross linking of research and best-practice information, and intranets/internet. KM aims to provide a sector-wide strategy to assist the sector break down barriers and allow a long awaited sharing of information for the benefit of patients, carers, planners and others.

The national strategy for healthcare information management in Australia

Although the application of computer based information systems in healthcare has been in Australia for some decades, Patient's electronic health record EHR, is not widely available or not integrated. Communication between providers mainly relies on paper records. Discharge referrals from hospital to doctor or clinics and community health are comparatively slow. Health care providers often spend a lot of time searching for exist information instead of direct patient care. All these deficiencies lead to inefficiencies, duplication and errors in health service.

A component of *HealthConnect*, the Australian national strategy for health information, is an electronic medication record system. The system will create and store details of all medication records for an individual consumer. The records may be collated from prescriptions written by doctors and dispensed by pharmacists at the patient's consent. The prescription given by a doctor can be electronically sent to the pharmacist, thus reduces the possibility of error caused by illegible handwriting. Drug interaction decision support system has been incorporated. With patient consent, a doctor can check medication history of the patient for potential drug interactions, thus decreases the chance of adverse events.

While healthcare is yet to embrace ICT and KM in the way that some other industries have there are now strategies in place in many health services and a rapid development of approaches and technologies. Associated with this is increasing recognition of knowledge as an asset and appropriate approaches to maximise its value.

The challenges of KM in public safety

Information systems and technology have the potential to greatly assist in improving public safety and can even eliminate the needs for certain types of policing. Knowledge management can assist in decisions about where best to deploy our limited resources, can inform policy and ensure our investment and operational decisions are supported by research. When professionals provide service to the public, instant access to information can enhance the effectiveness and safety of those interactions.

Technology already reduces public trauma through traffic controls, speed and alcohol detection devices, tools for safer public design, controlling commercial vehicle loading and safety features in vehicles. Some areas of healthcare have made extensive use of ICT, automation, robotics and KM. In both industries there are still areas that are dependent upon paper and manual processes.

In the future, technologies might assist traffic policing through the capacity to disable a vehicle when alcohol is detected, automatically fasten seat belts, limit a vehicle's speed to the

maximum allowed in each speed zone, allow patrol cars to remotely disable an offender's vehicle, make vehicles more "collision-proof", provide alerts to drivers or assist vehicles to avoid collision, monitor the roadworthiness of a vehicle's systems and even make an emergency call in the event of a collision.

Information systems and technology can enhance professional safety and improve service to our customers. Timely and accurate information for staff can assist in the effectiveness of interactions with the public. Mobile data terminals will provide information about vehicles, drivers, alerts, maps and safety information for professionals. Automatic vehicle location can improve the effectiveness of computer-aided dispatch systems as well as improve coordination of operations and staff safety.

Over the last decade, many governments have undertaken reforms of social and economic policies including those of the health and public safety sector. Like healthcare, policing is increasingly focused outputs and outcomes in terms of improvements. This includes deliverables relating to crime reduction and improvements in traffic safety. Improving outcomes is not possible without effective interagency collaboration based upon quality information and research evidence. There is increasing interest and efforts focused on improved collaboration and integration of projects between key agencies concerned with improving both health and public safety. The goals are to ensure that relevant, timely and accurate information is available and accessible to authorised users to support the business needs of all agencies in these sectors and their customers and to better monitor outcomes.

Integration of service within health and within public safety will be difficult without policy and planning, integrated information networks, a communications infrastructure with technical standards, common definitions, technology for interactive sharing of information across providers, and protocols for access to information for event management purposes as well as for monitoring. There is interest in providing knowledge-driven services as well as reinforcing individual responsibility. Both of these are dependant upon the provision of information to planners, professionals and to the front-line professionals.

Public services are increasingly driven by strategy. There are concerns about matching services with resources, the need to purchase or fund based upon analysis of need and of potential for gain, and to ensure information supports service provision. As important will be a base of information to enable better decisions, and for partnering relationships to emerge between agencies and between agencies and communities.

A strategy for information management needs to address eliminating much of the remaining manual processing and form-filling. It will need to provide immediate access to information for professionals at the point of service and electronic exchanges of information between agencies. When a professional delivers a service to a member of the public, they will be supported in the availability of information to aid their effectiveness. Information aids will include On-line electronic libraries to provide access to legal reference and other material. The communications facility will prepare Service for Mobile Data Terminals as well as making major improvements in emergency call taking and despatch. Mobile computers will enable professionals to interrogate central databases as well as issue computer-generated infringement notices. For police these can reduce much of the radio voice traffic. Both emergency call-taking and dispatch operators as well as mobile patrols will use to expedite attendance and to co-ordinate events. GPS (Global Positioning Systems) will assist dispatch operators to locate vehicles. This will ensure the closest available unit can attend as well as providing better

protection for mobile staff. Intelligence analysts will use the mapping facility to log and track events, trends, and identify associated factors.

Technology and information management can transform health and public safety services into being knowledge-driven. With their knowledge-bases, these services can be confident that their IT-supported health and public safety interventions are targeted, grounded in research, evaluated and will stand a high chance of returning an improvement in health and public safety.

Policing

In policing there are three key categories of internal information. One is the official and formal records. These include criminal records, registry and court information. This will contain details of offenders, previous convictions, vehicle registration including wanted vehicles, and registered and stolen firearms. The other category of information is the so-called intelligence or notings. Police are trained to observe and make notes. Not every interaction with the public or suspects will result in court proceedings. Information gathered from other events may be of valuable. Consider a scenario where a police officer pulls over a vehicle containing 4-5 occupants. The officer observes several firearms and baseball bats in the car and recognises one of the occupants as a known criminal offender. The occupants assure the officer they were going hunting in the forest and afterwards intended to enjoy a game of baseball.

While no offence has been committed the officer would definitely note as many details as possible which may be of interest in the future including details of occupants which might be of interest if one or more had criminal records, it may be of value to know with whom they were associating, vehicle details, and details of any firearms in the vehicle even if legally registered and with people registered to carry firearms.

Knowing the details of associates of known offender might assist in future investigations where the offender was implicated.

In the design of modern policing information systems there are a number of key objects around which information is organised. These include persons, places, vehicles, property and firearms. Modern policing keeps and open mind during investigations and persons of interest in relation to an event or suspected offence could well be victim, witness, family member or suspect.

The other type of information is that which is contained work-practices and business rules. In the case of police there are operating procedures for almost every eventuality they might encounter.

All three types of knowledge are supported by modern policing technology. In an ideal scenario when a call is made to an emergency telephone number the operator would have displayed on the screen the details of the caller, the address and the name of the person the telephone is registered to. The Emergency operator would have access to GIS (Geographical Information System) displaying a map showing the location of the caller, the location of available police vehicles. When an officer attends a call-out their in-vehicle computer will similarly display a map showing the location of the caller.

An intelligence analyst would review information and look for patterns. This might assist particular inquiries or inform managers on the best deployment of resources. A Commander or Shift Leader would direct patrols and other resources so as to minimise events to where offences are likely to happening, including time, day etc as advised by Intelligence Analyst.

Both healthcare and public safety are moving in the directions of recognising the value of information as an asset and improving their investment in systems and processes to optimise its value. There are commonalities in the visions for improved sharing of knowledge, greater standardisation of information. There are also similarities of challenges. There is value in an ongoing dialogue between the sectors and sharing of experiences as the many challenges to fulfilling the vision of Knowledge Management are overcome and the anticipated benefits are realised.

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Dr Soar came recently to academia from an executive career in ICT management in Australia and overseas. He has developed strategies and policy for ICT for NZ Police, NZ Health and NSW Rural Health. Recent major research includes Health survey System (WHO), research for Clinical IT in Aged Care (DoHA – Australian Department of Health and Ageing), Australian Health Informatics Education Report (DoHA), Australian Pathology Codes reference centre (DoHA), Review of NSW community services directory and referral system, international benchmarking research for MediConnect (DoHA), Review of hospital information systems in the Pacific Fiji/Samoa (AusAID), Evaluation of Discharge Referral System (NSW Health), Australian HL7 Management Strategy (DoHA), Review of Strategy for another university and consulting in hospital Finance and Administration in the Middle East. Dr Soar has been retained for APEC as an Advisor to developing countries. He has managed projects with up to 350 professional staff.

Dr Soar has established e-Health research centres at universities in Australia and is currently the Director of the Centre for Health and Aged Care Informatics at the University of Southern Queensland. His interests are in all phases of the systems development life-cycle from strategy, business case development, specification, design, acquisition, contract management, project management and quality customer service. Other areas include project rigour, performance monitoring and reporting, information management, risk management and benefits realization. He has a particular interest in environmental, social, organizational and political issues impacting IT success. He has qualifications in social science, computing, education and a PhD in business management.