There are only a handful of tertiary education institutes in Australia that produce Health Information Managers (HIMs), despite the high demand for qualified health information management professionals in the healthcare industry. The high demand in the industry has not been converted into student numbers in tertiary education courses, forcing some institutes to cease offering these courses (McDonald, 2016a). In an era where we are surrounded by technologies and systems that deal with healthcare data, it is puzzling why students are not attracted to health information management or health informatics courses. When I put this question to an open forum at the recent Health Information Management Association of Australia (HIMAA) conference, there were very interesting responses. Some indicated that this profession is ‘not sexy’ and it is rather ‘boring’. The views of some senior academics were that universities should concentrate on converting people already with clinical expertise, such as nurses, into HIMs through postgraduate and research programs, rather than attempting to create HIMs at the undergraduate level. Others had pragmatic views about how courses should be offered in offline mode to attract more students. All of these are valid arguments. On this premise, this article explores skills needed by new-age HIMs and how tertiary education sectors could embrace the new wave of change.

**E-health background and context**
What does the future hold for the health information management profession? In order to understand this, let us take a step back and get some not-so-new terminologies clarified. The future of the health information management profession is closely linked with, among other things, the terms e-health and health informatics. According to one of the early definitions, e-health refers to the field in the intersection of medical informatics, public health, and business (Eysenbach, 2001). The World Health Organization (WHO) gives a broader definition terming e-health to be the use of information and communication technologies (ICT) for health (World Health Organization, 2016). Alongside the term e-health, regularly appears the term health informatics, which is referred to as medical informatics in Eysenbach’s (2001) definition above. The United States National Library of Medicine defines health informatics as the interdisciplinary study of design, development, adoption, and application of information technology IT-based innovations in healthcare services delivery, management, and planning; making health informatics a subset of e-health. Regardless of the finer points in the definition, it is evident e-health encompasses the fields health, ICT and business.

The union between healthcare and ICT has been occurring for many decades. Cesnik (1996) cites van Bimmel and Shortliff’s forward to the Fifth World Congress on Medical Informatics in 1986, where they suggest health informatics began as medical and nursing informatics in the 1970s. In the 1980s, the emphasis was on artificial intelligence and decision-support systems linking with database technology in the medical domain (Cesnik, 1996). The 1990s marked the era of tools, software, methodologies, techniques and experiences in relation to health informatics. Prior to 2000, almost all of these e-health initiatives were either carried out at the departmental level or as research projects. Since 2000, e-health systems have expanded into the community in the form of electronic health record (EHR) systems, due to technologies such as Internet and web. However, whether their implementation has been successful is questionable.

**Why do e-health implementations fail?**
Over the years there have been many efforts to implement EHR systems, not just in healthcare organisations but also at national level. Unfortunately, the number of failed e-health implementations has outnumbered the successes. Table 1 shows outcomes of selected e-health initiatives around the world based on reports available online. Of the eight reported projects, only two claimed to be successful e-health initiatives that delivered what was promised and were accepted by users. There are two projects for which outcomes are not yet fully known. These include the Australian EHR initiative and a similar project in the United States. Most importantly, four out of eight e-health initiatives failed, costing billions of tax-payers dollars.

When analysing the reported reasons for failures of e-health initiatives, the recurring theme seems to be the lack of uptake by clinicians. E-health is inherently complex, yet solutions are developed by professionals who are not trained in e-health (Coiera, 2013). Clinicians and ICT professionals know their own respective domains, and neither of these groups is conversant with the intricacies associated with the other domain.

**CMMI® for e-health implementation in healthcare organisations**
Not all healthcare organisations aspire to be fully e-health compatible. In fact, e-health needs of organisations vary based on size and strategic directions. Capability Maturity Model Integration (CMMI®) is a popular model developed by Carnegie Mellon University, utilised by various disciplines to understand the maturity of organisations over a period of
Table 1: Compilation of successful and failed e-health initiatives

<table>
<thead>
<tr>
<th>E-HEALTH INITIATIVE</th>
<th>OUTCOME</th>
<th>REASONS FOR SUCCESS OR FAILURE (AS REPORTED)</th>
</tr>
</thead>
</table>
| Royal Children’s Hospital (McDonald, 2015, 2016b) | Success | – Relatively small scale as it involved one hospital  
– Clear strategic direction and proper planning  
– Involvement of over 65 ICT and health information management professionals to create an integrated system  
– Extensive consultation with stakeholders.  
– Integrating with existing software.  
– “Live-go” approach to all areas of the hospital, without leaving certain areas in the “hard-to-do basket” |
| Danish e-health system (Kierkegaard, 2013) | Success | – Relatively small population (5.5 million)  
– Not a nation-wide one system, but multiple suppliers to choose from.  
– Use of four different EHR systems for the purpose of catering for various sectors such as primary care, hospitals and telemedicine, while tackling interoperability issues.  
– Strategic direction from the government with stricter guidelines and policies that limit the number of e-health systems permitted per region. |
| Australian EHR/PCeHR (Dunlevy, 2015; News_Limited, 2013) | Unknown | – Lack of consultation with all key stakeholders.  
– Usability issues of the system and system immaturity.  
– Lack of uptake from consumers and clinicians.  
– Rushed project with lack of strategic direction.  
– Poor implementation of workflows that did not suit all healthcare organisations. |
| US e-health initiative (Braunstein, 2015; Kolbasuk-McGee, 2011b) | Unknown | – Allows clinicians and healthcare organisations to purchase or implement IT systems that are suitable for their workflows.  
– Uses incentives to increase clinician uptake.  
– Interoperability remains to be an issue |
– Limited use of full-time employees (less than 30), who know the system requirements, and heavy reliance on contract staff (over 300).  
– Lack of efficient project management. |
| Google Health (Kolbasuk-McGee, 2011a) | Failure | – Lack of uptake from the general public and clinicians.  
– Concerns over security and privacy.  
– Lack of linkage with external data sources. |
| UK. E-health Records (Kolbasuk-McGee, 2011b) | Failure | – Lack of uptake by clinicians even when it was mandated to do so.  
– Inflexible system that did not allow changes to cater for different workflow scenarios  
– Centralised procurement model where the approach is top-down |
| HealthSmart implementation in Victoria Australia (McDonald, 2013) | Failure | – Fully implemented only in one healthcare service provider (initially planned for 19) and other organisations did not implement for various reasons such as cost, clinical safety, poor experience, not serving the purpose or already having similar systems.  
– Poor planning and inadequate understanding of the complex requirements of clinical ICT systems.  
– Underestimated project scope, costs and timelines, as well as the required clinical and other workflow redesign and change management efforts. |

Level 1-Initial level in e-health implementation:
A key characteristic of Level 1 of CMMI® is the use of disconnected IT systems to complete work-items. Generally, enthusiastic clinicians and/or HIMs initiate these systems. They would have their own local database or software tools to support some work-items. As recently as in October 2016, I was asked by a clinician of an Intensive Care Unit (ICU) of a major south-western Sydney hospital, to develop a Microsoft Access database to collect all insertions of central venous catheters that include patient demographics, procedural issues and catheter characteristics. Only two nurses used the system and they would enter data and create reports to justify funding needs. At CMMI® Level 1, there is no strategic support provided for projects. Continuity of such systems is doubtful due to lack of funding and upper management support.

Level 2 – Managed level in e-health implementation:
Partially connected IT systems, which support some parts of processes, are the main feature of Level 2 organisations in CMMI® model. Generally, there is some managerial support, but limited budget to support larger e-health initiatives. Systems are used for day-to-day operational activities. Systems such as staff scheduling are a good example for Level 2 organisations. These systems have some level of connectivity with other divisions within the same organisation, but lack integration with external organisations. These e-health projects may have started with initial funding and may be completed by externally hired IT professionals. When systems need modifications and improvements external IT support staff would be
called to provide these services. However, lack of scalability built into these one-off IT projects would force systems like these to be discarded when they no longer serve the business needs.

**Level 3 – Defined level in e-health implementation:**
Organisations that are matured up to Level 3 would have fully connected IT systems that support some processes. At this level, organisations would have a significant amount of initial funding invested in getting a commercial level application. Some examples would be a primary care system linking up with a pathology service, Medicare or private health insurance organisations. For successful integration, internal processes have to be well defined. Systems of this nature would continue to be managed and maintained to serve the business needs, as there are contractual obligations. Level 3 healthcare organisations would have internal IT staff or contractual arrangements with external IT organisations. The data derived from systems would be utilised for process operations and decision-making. However, e-health systems like this would produce data outputs that need separate analysis to derive meaningful information. Nevertheless, the availability of these data is an advantage; but having to use secondary systems, such as Excel, to interpret the data to information is an issue.

**Level 4 – Quantitatively managed level in e-health adoption**
At Level 4 of CMMI® almost all divisions within healthcare organisations are connected through ICT. The e-health implementation of Royal Children’s Hospital (McDonald, 2015) is a good example. The most important characteristic is the full connectivity and all personnel who interact with workflows use the system to complete their work activities. Further, having features such as “dashboards” that give real time data for middle managers to understand the operational aspects in a quantitative manner is a key feature. Further, there will be an in-house ICT team dedicated for maintenance and further development of the system. Significant initial investments, extensive training for clinicians and support from upper management are other factors that help success of Level 4 organisations. Replication of the system into another organisation would require significant changes to the system as workflows may vary from one organisation to another.

**Level 5 - Optimising level in e-health adoption**
“Franchise” is the key word associated with Level 5 of CMMI® in the business domain. For example, McDonald’s, the multi-national giant in the fast-food industry, achieved its success not by selling burgers, but selling their optimised processes to franchisees. In the context of healthcare organisations, whether all processes of the organisation can reach this level of maturity is questionable simply due to the complex and diverse nature of the healthcare workflows. Certain well-defined processes such as pathology have achieved this to some extent, while other aspects still need comprehensive analysis. As highlighted by Coiera (2013) healthcare processes are not understood comprehensively by anyone, resulting in failed e-health initiatives.
**ICT Skills and knowledge needed for e-health CMMI® Journey**

Having a high level of maturity, CMMI® model is desirable when trying to achieve benefits of e-health. This applies equally to individual organisations and the nation as a whole. There are many factors such as funding, strategic directions, policies, competition, technology, processes, people and culture, skills and training of the healthcare workforce that contribute to the progress of organisation’s maturity in e-health adoption through the CMMI® journey.

**HIM training for e-health**

In e-health implementation, the primary responsibility is with HIMs as they are trained across both domains: health and ICT. Therefore, it is worth articulating the training requirements for HIMs to meet the need in the healthcare sector for competent ICT professionals.

Evidently, HIMs receive excellent training in clinical concepts, terminologies and classifications. In the context of e-health, it is imperative for them to also receive training in ICT. The ICT skill set needed by HIMs is categorised into ten items below.

1. **General ICT literacy** – ability in use of Internet, email, software for scheduling, word processing, spreadsheets & presentations, and web & mobile applications.

2. **Healthcare ICT systems knowledge** – ability to use hospital management systems, electronic medical/health record systems, disease surveillance immunisation records management software and various public health registries.

3. **Specialised medical ICT systems knowledge** – understanding the applicability of systems such as auto-coding software, diagnostics software, laboratory software, genomics and omics registries, biobanks and clinical trial software.

4. **ICT systems administration** – ability to do basic installing, supporting, and maintaining servers or other computer systems, and planning for and responding to basic service outages and other problems.

5. **Design, development and implementation of ICT systems and management of such ICT projects** – ability to analyse the business needs, design feasible ICT systems that would cater the business needs, communicate requirements with various stakeholders, implement ICT systems and evaluate the systems regularly to assess the suitability of systems to cater the changing business needs.

6. **Knowledge in ICT system architectures and infrastructures** – understanding of the web and mobile system architectures, design solutions based on distributed networks and cloud-based architectures, and the capacity technologically to address issues in relation to privacy, security and accessibility of healthcare data.

7. **Data analytics and statistical knowledge** – ability to collect, analyse, interpret, present, and organise healthcare data, in order to create statistical models, using appropriate software tools that would assist in problem-solving and/or decision-making.

8. **Data visualisation, predictive analysis and simulation knowledge** – use various data visualisation tools to create visual models using healthcare data, understand and utilise higher order algorithms for predictive analysis and use healthcare data for creating scenario simulation that would help in decision-making and future planning. Understand the use of big data analytical concepts, tools and techniques.

9. **Health data governance and ethics knowledge** – understanding of standards, policies, guidelines and procedures that are applicable to healthcare data, ability to use technology to its fullest potential in order to collect, store and process healthcare data according to applicable laws, and act as the data custodian for enterprise-wide healthcare data.

10. **Knowledge of new technological innovations and trends** – ICT is growing at a faster pace that requires HIMs to be continuously in tune with the new trends and developments in the ICT sector and evaluate the usability and applicability of such technological solutions to the healthcare setting.

While the healthcare organisation is taking a journey through the CMMI®, individuals working within the organisation also have to make their own personal journey in gaining the required skills and knowledge. Table 2 maps ICT skills identified above and knowledge categories into the levels in the CMMI® using three aptitude levels as L (low), M (medium), and H (high).

<table>
<thead>
<tr>
<th>CMMI® LEVEL IN E-HEALTH ADOPTION</th>
<th>ICT SKILLS AND KNOWLEDGE CATEGORIES NEEDED IN E-HEALTH SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1-initial</td>
<td>L-M L-M L L - - L L - -</td>
</tr>
<tr>
<td>Level 2-managed</td>
<td>L-M M L L-M L L L-M - L-M -</td>
</tr>
<tr>
<td>Level 3-defined</td>
<td>M-H M-H L-M L-M L-M L-M L-M - M -</td>
</tr>
<tr>
<td>Level 4-quantiitatively managed</td>
<td>M-H M-H M M-H M M-H L-M M-H L-M</td>
</tr>
<tr>
<td>Level 5- optimising</td>
<td>H H H M-H M-H H M-H H M-H</td>
</tr>
</tbody>
</table>

Table 2: ICT skill and knowledge categories mapping to CMMI levels
... individuals working within the organisation also have to make their own personal journey in gaining the required skills and knowledge

For an organisation at CMMI® level 1, where the IT systems are disconnected and used only to complete some work items, a HIM would only be required to have low to medium levels skills under 1 and 2, and low-levels in 3, 4, 7 and 9. Generally, along with clinical coding and classification knowledge, this would be a full-time job for a single HIM in a small healthcare setting, which is at CMMI® Initial stage in e-health adoption. However, as the organisation grows through different levels of maturity, there would need to be growth in the team of HIMs, both in numbers as well as in the skill set. When interpreting the data in the above table, it needs to be understood that the full set of above skills and knowledge is unlikely to be acquired by one single person. Rather, the expectation is that there will be a team of HIMs who each would specialise in certain areas.

**Training HIMs for CMMI® journey**

When looking at the skill set above and level of competency required, it needs to be noted that courses are needed to cover content in varying depth and breadth. Using the Australian Quality Framework (AQF)'s (Department of Education and Training, 2013) levels of courses, Table 3 indicates mapping between courses at varying AQF levels, skill categories and expected aptitude levels to be covered in these courses.

Table 3 shows certificate courses ranging from certificate Level I to IV, which would be suitable to train health information management professionals for organisations that are operating at CMMI®’s initial and managed stages. As the organisation matures into defined and quantitatively managed stages, at a minimum it would be required to have health information management professionals who have completed courses at bachelor or honours level. Further, for quantitatively managed and optimising levels it is important to have HIMs who may have completed postgraduate courses or with higher degrees in research skills.

**Concluding remarks**

So, going back to the original questions, “how do we make the health information management profession sexy?” The health information management profession needs re-branding and long-term clear career path mappings. It is important that e-health is an integral part of curriculums. In the future, e-health professionals will be in high demand and failure to integrate e-health into curriculums would be disastrous for the profession. On the other hand, integrating e-health has the potential to attract the diversity of students to courses that the profession needs for all levels of e-health maturity.

The second argument was that all health information management courses should be at postgraduate level. Clearly, this is not the direction that we need for the future of e-health. In order to create a versatile team of HIMs that can serve all maturity levels of e-health implementations, we need to have a health information management professional education frameworks that spans from certificate levels to postgraduate studies. While some high-AQF-level courses, such as postgraduate courses, are suitable for the development of certain skills for high levels of CMMI®, the bulk of the health information management professional education and training could take place in certificate level or undergraduate courses as many organisations are still at lower levels of CMMI®.

Should all courses be online? While this is a great suggestion, it needs to be understood that certain soft skills such as communication and collaboration in a group setting are a key component needed for the success of e-health initiatives. It is also hard to self-develop certain ICT skills such as programming if students are not in a practical environment. While offline studies would certainly suit training the clinical side of the health information management profession, in order to develop engaged e-health professionals who can lead e-health initiatives, a multi-model teaching approach is much more suitable.

<table>
<thead>
<tr>
<th>COURSE TYPE OFFERED BY TERTIARY EDUCATIONAL ORGANISATIONS OR OTHER PROVIDERS</th>
<th>SKILL AND KNOWLEDGE APPROPRIATE TO BE COVERED</th>
<th>DEPTH AND BREADTH OF CONTENT (APTITUDE LEVEL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certificate I-IV (AQF levels 1-4)</td>
<td>1, 3, 4, 6</td>
<td>L-M</td>
</tr>
<tr>
<td>Diplomas/Advanced Diplomas/ Associate (AQF levels 5-6)</td>
<td>1, 2, 4, 5, 6, 10</td>
<td>M-H</td>
</tr>
<tr>
<td>Bachelor Degree/Bachelor Honours Degree/ Graduate Certificate/ Graduate Diploma (AQF Levels 7-8)</td>
<td>2, 3, 5, 6, 7, 9, 10</td>
<td>H</td>
</tr>
<tr>
<td>Master Degree/Doctoral Degree (AQF Levels 9-10)</td>
<td>7, 8, 9</td>
<td>M-H</td>
</tr>
</tbody>
</table>
In this article, we only took into consideration the ICT skills and knowledge needed by HIMs for successful e-health implementations. Similar mapping needs to be carried out from the clinical knowledge perspective to understand the clinical knowledge training needs of HIMs.

In conclusion, we need a multitude of courses to educate HIMs for the future. Healthcare organisations need teams of people with multiple ICT skills at various levels if they want to succeed in the CMMI® e-health journey. Tertiary education institutes aptly responding to this rapidly growing need for e-health skills in the market would not only produce the many successful e-health professionals, but also lays the foundation for successful e-health implementations in the future.

References


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