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Meaningful Use and Meaningful Curricula: A Survey of Health Informatics Programs in the U.S.

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Meaningful use and meaningful curricula: a survey of health informatics programmes in the USA

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Abstract: The introduction of the US government's *Meaningful Use* criteria carries with it many implications including the training curriculum of healthcare personnel. This study examines 108 health informatics degree programmes across the USA. First, the courses offered are identified and classified into generic classes. Next, these generic groupings are mapped to two important frameworks: the *Learning to Manage Health Information* (*LMHI*) academic framework; and the *Meaningful Use* criteria policy framework. Results suggest that while current curricula seemed acceptable in addressing *Meaningful Use Stage 1* objective, there was insufficient evidence that these curricula could support *Meaningful Use Stage 2* and *Stage 3*. These findings are useful to both curriculum developers and the healthcare industry. Curriculum developers in health informatics must match curriculum to the emerging healthcare policy goals and the healthcare industry must now recruit highly trained and qualified personnel to help achieve these new goals of *data-capture*, *data-sharing* and *intelligence.*

Keywords: workforce education; health information technology; informatics education; health information management; meaningful use; curriculum development; EHR; electronic health record; electronic healthcare.

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1 Introduction

In July 2010, the US administration put forth an ambitious five-year transition plan to move from a complete/partial paper health record system to an entirely Electronic Health Record (EHR) system. In fact, this EHR framework was just a final step in the journey that started in 2004 with its mention in the State of the Union address by President Bush and a consequent adoption of ten-year plan, to the Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009 (Department of Health and Human Services, 2010a). The new framework is a significant landmark for the US healthcare systems – a clear commitment to a no-return-to-paper-records era. This policy shift has brought along with it not only a health information technology (IT) and healthcare practice shift, but also garnered concern from all the stakeholders of the healthcare system. From healthcare users to healthcare professionals; health IT software vendors to researchers; policy-makers to policy-enforcers; it is clearly a new day. The stakes are high and come with the promise of a better, effective and efficient healthcare system with abated physician mistakes, huge cost savings and improved healthcare for millions (Hsieh, 2009; Mohapatra, 2009).

The Organization for Standardization (ISO) has defined EHR to mean a repository of patient data in digital form, stored and exchanged securely, and accessible by multiple authorised users. It contains retrospective, concurrent and prospective information; and its primary purpose is to support continuing, efficient and quality integrated healthcare (Hayrinen et al., 2008). Many researchers agree that EHR systems would lead to improved healthcare, lowered costs, increased efficiency (Poissant et al., 2005; Dorr et al., 2006; Jha et al., 2006) and even enhanced privacy and security (Department of Health and Human Services, 2010b). This paper discusses the significance of this definition later, but it suffices at this point to mention that many other definitions and related concepts such as Electronic Medical Records (EMR); Computerised Patient Records (CPR) exist (Amatayakul, 2004; Sanchez et al., 2005).

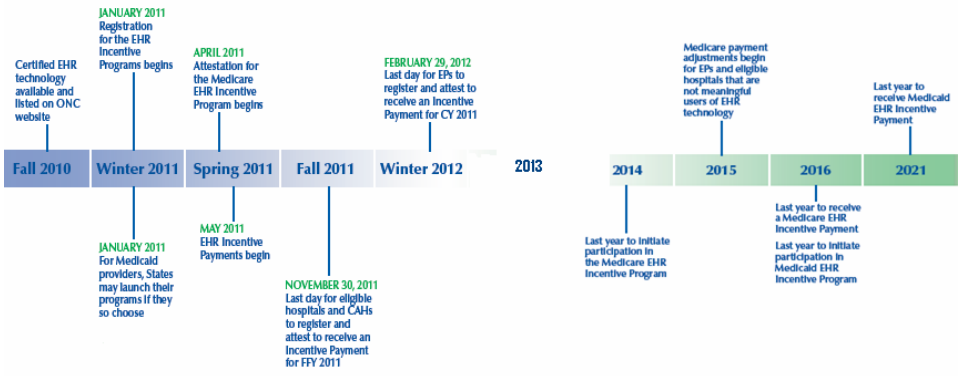
Though the use of computer-based patient records (CPR) persists in some circles, the globally accepted generic term for vision of electronic patient care systems is EHR (Sanchez et al., 2005). This is evidenced by a number of works that have focused on finding consensus on the potential meaning of the terms (Erstad, 2003; Jha et al., 2006). Though a thorough discussion on EHR terminology evolution is beyond the scope of this paper, it would be important to mention that three key terms have been used in literature

interchangeably. They are computer-based patient records, EMRs and EHRs. The term computer-based patient records (CPR), which was used in the 1980s, was progressively replaced by the term EMR in the 1990s. Currently, EMR has evolved to what is now known as EHR.

1.1 Meaningful Use

The US Department of Health and Human Services (2010b) ruling on the *Meaningful Use* of EHR set forth both the definition and standards by which to judge an EHR system. *Meaningful Use* is defined as the use of certified EHR technology to improve quality, safety and efficiency of healthcare while reducing health disparities. Additionally, it has a purpose to engage patients and families in their healthcare to improve care coordination, and public health while maintaining privacy and security. Finally, *Meaningful Use* has three main components: the use of certified EHR in a *Meaningful* manner (e.g. e-prescribing); electronic exchange of health information to improve quality of healthcare; and the use of certified EHR technology to submit clinical quality measures and other mandated measures. According to these stipulations, vendors can ensure that their systems match up to the required capabilities and providers be assured that the system they acquire will aid in achieving the 'meaningful use' objectives – a five-year national initiative to adopt and use EHR (Department of Health and Human Services, 2010c). The *Meaningful Use* framework (Centers for Medicare and Medicaid Services, 2010) timeline and deliverables at each of the three phases were summarised in Figure 1.

Figure 1 The meaningful use timeline (see online version for colours)



Notes: *Stage 1* (beginning in 2011) focuses on electronic capturing of health information in coded format; using the information to track key clinical conditions and communicating this information for care coordination purposes.

Stage 2 (beginning in 2013) builds on *Stage 1* criteria to encourage the use of health IT for continuous quality improvement at the point of care and the exchange of information across diverse healthcare units.

Stage 3 (beginning in 2015) focuses on promoting improvements on quality, safety and efficiency, and also decision support on national priority conditions.

Source: Centers for Medicare and Medicaid Services (2010)

1.2 The Learning to Manage Health Information (LMHI) framework

The Learning to Manage Health Information (LMHI) framework was first published in 1999 by the National Health Service Information Authority with the goal of establishing a common health informatics framework for clinical health professionals at different levels (Severs and Pearson, 1999; National Health Service Information Authority, 2009, p.47). It also included outcomes and standards for professional practice in eight areas of learning in health informatics. Supported by 28 organisations, it was intended to be a source of advice and guidance. In 2002, *Learning to Manage Health Information*: *Moving Ahead* was published to provide additional guidance and interpretation in accordance with important developments in the field of information management and educational approaches. Between 2001 and 2004 this framework was tested in two universities in the UK, followed by a four-part publication entitled: *Health Informatics Education and Development for Clinical Professional: Making Progress?* This framework was further tested for standards in 2006. In the most recent LMHI 2009 edition, former editions have been modified and improved upon to cover the following main themes most important to clinicians:

- protection of individuals and organisations
- data, information and knowledge
- communication and information transfer
- health and care records
- the language of health: clinical coding and terminology
- clinical systems and applications
- e-health: the future direction of clinical care.

1.3 Health information management training

Just a few years ago, the American Medical Informatics Association (AMIA) developed a goal to train 10,000 clinicians in medical informatics by 2010 (Hersh and Williamson, 2007) as a part of the desire to fill the growing needs for trained personnel in health informatics. This goal reveals the critical problem of a workforce that is small and ill-equipped. Researchers have continued to raise concern on the need for curriculum development that addresses teachers, trainers and management (Purg and Wiechetek, 2011).

A recent study (Murphy et al., 2004) blamed slow progress of informatics education on the lack of understanding of health informatics between health science educators – majority of whom equate informatics with information technology (IT) skills. Additionally, it was found that confusion and uncertainty ensues as to who is ultimately responsible for overseeing health informatics education and a lack of an overview as how the different sectors and stages fit together, given the interdisciplinary nature of the field. Top on the list of recommendations was the development of national curriculum to handle these deficiencies. However, some researchers have argued that while many countries have recognised the urgent need for a highly educated and trained workforce in information

management, universities have been slow to respond to this need until the past decade (Brittain and Norris, 2000).

2 Statement of problem

The advent of *Meaningful Use* of EHR presents not only a challenge of using certified technology to handle healthcare needs; it also presents a challenge of the preparedness of *Meaningful Users* who must use these technologies. Health informatics and healthcare systems implementation are being evidenced across Europe and Asia (Grimson, 2001; Nguyen et al., 2008). Only five years ago, about a quarter of US physicians were reported to be using the EHRs (Jha et al., 2006). But today, the goal is to reach a 100% usage. Health and biomedical informatics as a field is experiencing varying challenges. First, there exist clinical challenges like the synchronisation of the system with workflow patterns that needs to be achieved. Interoperability of standards and agreement on terminology are still prevalent. To top it all, there are costs to be incurred and privacy and security is yet to be ascertained (Hersh, 2004). On the research side, infrastructure is still being developed and secondary reusable data are but hard to come by. However, in both clinical and research settings, there is a need for an adequately trained workforce of professionals and users. For one thing, *Meaningful Use* presupposes *Meaningful Users*.

According to American Health Information Management Association (AHIMA), a study conducted by the Center for Workforce Studies at the University of Albany and University of New York found that 75% of survey respondents indicated the lack of qualified applicants to satisfy all vacant positions in Health Information Management (HIM) and that there are insufficient number of certified professionals to fill all required positions and roles in HIM. Additionally, it concluded that it would be essential to improve the 'understanding of both architecture and application' of technology in the HIM education (AHIMA, 2004).

The US Department of Labor Bureau of Labor Statistics projects that HIM jobs are bound to grow in USA from the yearly average of 2500 new graduates that join the workforce every year (Dohm and Shniper, 2007; AHIMA, 2008). However, the US Bureau for Labor Statistics projects a dearth in HIM professionals in the coming years due to an ageing workforce. This means that while we can expect the need to grow, we must anticipate the availability of *old* professionals to drop. In view of these challenges, AHIMA in 2008 called for government, industry and higher education to acknowledge and act on the following recommendations:

- the evolution of the HIM curriculum and informatics
- expansion of HIM programmes for master's and doctorate-level education.

Biomedical informatics workforce requires mostly post-secondary training. The Bureau of Labor Statistics projected jobs requiring a post-secondary vocational award or associate degree to be over 20 million openings (Hecker, 2001). With the advent of EHR implementation, the number of professionals needed – more specifically in the biomedical informatics – is bound to increase even more. Wing and Langelier (2004) projected that in view of the coming change, health information professionals must be

willing to rethink their traditional jobs and acquire new skills in order to meet challenges and claim new roles. Gebbie (1999) commented that many public health workers were originally hired for entry-level positions which demanded specific skills rather than a general perspective. However, as programmes and funding shift, and as employees seek advancement, these narrowly defined positions soon change to ones in which their lack of broad public health perspectives and skills are more limiting. The implication is that the current workforce training and education would not be able to sustain the imminent changes that are in the horizon. Additionally, the question of quality of education also arises (Pillay and Kimber, 2009). Some researchers have investigated the adoption of EHRs and have enumerated barriers to their adoption and implementation (Ford et al., 2006; Ludwick and Doucette, 2009). Others have suggested the involvement of policy-makers in stepping up adoption (Baron et al., 2005); yet only few researchers (e.g. Bakken et al., 2003) have looked into the curricula concerns of the adoption of EHRs.

3 Statement of objectives

This study examines the current curricula that are being used to train today's health information technology professionals. These curricula will then be assessed in the light of the LMHI framework as well as the *Meaningful Use* criteria set to see whether these curricula meet these academic and policy benchmarks. To achieve this objective: the study first identifies and organises HIM and biomedical informatics programmes in the USA into subject areas. Second, these subject areas are mapped against the LMHI (Severs and Pearson, 1999) framework and the *Meaningful Use* criteria.

4 Methodology

4.1 Sample

The target population for this study was educational institutions offering associate degrees, bachelor's degrees and master's degrees in Health Information and Informatics Management (HIIM), health informatics (HI) or biomedical informatics (BMI). A total of 150 institutions were obtained through an online search. One of the main databases for this listing was the website of the Commission on Certification for Health Informatics and Information Management (CCHIIM). The CCHIIM is an AHIMA commission dedicated to assure the competency of professionals practicing HIIM. Searches on institutions not found on this list were conducted through general internet search engines. Once this list was obtained, the institutional websites were then searched to extract the curricula information. Forty-two of the institutions originally searched were dropped from the final analysis due to unclear information or absence of online curricula. For instance, institutions with course listings not providing at least a brief course description were dropped.

Finally, 108 programmes were selected for analyses. These programmes comprised 41 associate degree programmes, 45 baccaleaureate programmes and 22 master's degree programmes. This final sample represented about 11% of the population of post-secondary HIM programme offerings in the USA (according to the National Center for Education Statistics, US Department of Education, the population of institutions totalled about 961).

4.2 Procedure

To provide a theoretical and practical basis for understanding and interpreting results, the *Meaningful Use* stages, definitions and objectives were first matched with the LMHI framework. As it can be seen in Table 1, each of the *Meaningful Use* stages is characterised with a general description, and the key objectives and user support capabilities are briefly explained according to the outlines by the US government. The user support capabilities describe the certification criteria to support the achievement of *Meaningful Use* at each stage. Specifically, it addresses not just the capability of the certified system, but also suggests the skill that the *Meaningful User* must have in order to interact with the system meaningfully. Hence, these system capabilities also represent user knowledge base for understanding and using the system. In addition to the key objectives mentioned, the different stages are matched with the knowledge area most critical to the *Meaningful User*.

Table 1 Meaningful use criteria and *LMHI* knowledge areas

Stage	*General description*	*Key objectives/user support capabilities*	*Knowledge area (LMHI)*
Stage 1	Data capture	• Record, store, retrieve, manage (medications; lab; radiology/imaging; referrals)	• Clerical and service audit • Working clinical systems • Data quality and management
Stage 2	Data sharing	• Not yet finalised	• Communication • Confidentiality and security • Telemedicine and telecare
Stage 3	Decision-support	• Not yet finalised	• Knowledge management • Secondary uses of clinical data and information

It must also be noted from Table 1 that these knowledge areas required from *Stage 1* through *Stage 3* are cumulative in nature. Hence, the knowledge areas matched with each stage represent the characteristic of the knowledge base that is required for optimal achievement of the stage objectives. For example, three critical knowledge areas are identified to be crucial to *Meaningful Use Stage 1*, namely: *clerical and service audit*, *working clinical systems* and *data quality and management*. Because these knowledge areas are also needed for Stages 2 and 3, they must not be considered as being mutually exclusive. Additionally, since the objectives of *Stage 2* and *Stage 3* of the *Meaningful Use* criteria are still to be finalised, the knowledge areas designated as relevant to these stages were based on the general goal of each of the stages.

Second, the lists of courses offered by each programme were then analysed and classified into certain generic classes based on their course description and the grouping of informatics subject areas by Brittain and Norris (2000) (see Table 2). For courses that did not explicitly convey the subject matter from its title, an attempt was made to read the course description from the catalogue. Once an adequate description of the main content of the course was ascertained, it was then classified under a major heading as shown in Table 3.

The Brittain and Norris (2000) classification in Table 2 provided guidance in the classification in Table 3, howbeit not absolutely. For example, some of the topic examples mentioned in the Brittain and Norris's (2000) table were considered as a topic category in this present study. Hence, a topic area like ethics, security and medico-legal issues are actually two independent topic categories – healthcare information privacy and security; and quality management and legal issues – in this study. It is worthy to mention that another group of courses termed 'support courses' were added. These are courses that did not exactly fall into one of the major areas of the health informatics management field. Examples include: music, theater arts, general psychology and general sociology.

Consistent with other previous studies on HIIM curricula and training, an attempt was also made to map these courses with the LMHI framework that has been used to define 'expectations for learning' (Brittain and Norris, 2000; Murphy et al., 2004). Although a variety of educational 'gold standards' have been proposed to define and assist the incorporation of health informatics into academic curricula, the *LMHI* framework stands out among all (Murphy et al., 2004).

Table 2 Examples of course groupings

Topic category	*Example topic*
Clinical and biomedical	• Clinical systems
	• Bio-informatics: computers in bio-science
	• Principles of clinical medicine
	• Physics and instrumentation of medical magnetic resonance
	• Introductory biostatistics
Information technology	• Databases and data structures
	• Artificial intelligence
	• Software engineering
	• Decision support systems
	• Advanced programming
Healthcare information	• Healthcare information and the management of information
	• Healthcare information: contracting, quality and performance
	• Health knowledge management
	• Electronic health record
	• Ethics, security and medico-legal issues
Health management and policy	• Healthcare economics
	• Project management
	• Organisational behaviour and management
	• Health policy and information strategy
	• Risk management

Source: Adapted from Brittain and Norris (2000)

Table 3 Course groupings in the study (partly based on Table 2 classification)

Course groupings
Health information/data management
Health project management
Quality management/legal issues
Electronic health records
Health information classification/coding
Healthcare information systems
Management (general)
Healthcare administration/records handling
Healthcare information privacy and security
Systems analysis and design
Computers/information systems
Research/capstone project/lab in health informatics
Medical terminology/pharmacology/pathophysiology
Biology/anatomy and physiology
Clinical experience/practicum
Quantitative methods/statistics
Communication skills in health informatics
Support courses

Despite the reviews that have been made to the original framework, it is the view of the National Health Service of the UK that the components of the *LMHI* model are still relevant (Murphy et al., 2004). Hence, the document establishes the following core elements of a generic framework for the health informatics component of clinical education (Severs and Pearson, 1999):

- clerical and service audit
- working clinical systems
- data quality and management
- communication
- confidentiality and security
- telemedicine and telecare
- knowledge management
- secondary uses of clinical data and information.

4.3 Analyses

Since the interest of this research was to investigate at a country level (rather than at institution level) whether the *Meaningful Use* criteria were supported by a 'meaningful' curriculum, courses offered in each subject grouping were counted for every HIM degree

programme at each of the institutions in this study. Hence, each number in the table of course offerings represents a course. For example, 50 in column one, row 3 in Table 4 means that 50 courses are taught at the associate degree level in the area of health information and data management, in all the institutions studied. This number holds for all the programmes that taught this subject, and could include one or more courses taught by the same institution. For example, if a course – HIM – is taught as HIM-1, HIM-2 and HIM-3 by a single institution, these courses will contribute for a total tally 'three' under the subject group; and depending on the course level (freshman, sophomore, junior, senior, etc.).

Table 4 HIT programmes results for associate degree

Course offerings	*Freshman*	*Sophomore*	*Total*	*% Course*	*LMHI Area*
Medical terminology/ pharmacology/ pathophysiology	90	29	119	12.55	Knowledge management
Communication skills in health informatics	75	8	83	8.76	Communication
Health information/ data management	50	30	80	8.44	Data quality/management
Biology/anatomy and physiology	44	14	58	6.12	Knowledge management
Quality management/legal issues	39	46	85	8.97	Data quality/management
Health information classification/coding	39	75	114	12.03	Working clinical systems
Computers/information systems	39	9	48	5.06	Working clinical
Clinical experience/practicum	28	50	78	8.23	Knowledge management
Healthcare information systems	26	17	43	4.54	Working clinical systems
Quantitative methods/statistics	18	17	35	3.69	Secondary uses of data/info
Electronic health records	12	13	25	2.64	Knowledge management
Management (general)	12	29	41	4.32	Knowledge management
Healthcare administration/records handling	10	22	32	3.38	Clerical and service audit
Research/capstone project/ lab in health informatics	10	9	19	2.00	Knowledge management
Health project management	1	1	2	0.211	Data quality/management
Healthcare information privacy and security	1	0	1	0	Confidentiality and security
Systems analysis and design	0	0	0	0.00	Working clinical systems
Total	553	395	948		
% at Level	58.33	41.67			

The data were also classified according to the level at which each is offered (e.g. freshman, sophomore, junior, senior, etc.). Since the interest was on aggregate percentages of courses being taught at each level, and for each group of courses, at the national level, each number in the table represents the total number of courses offered by each programme. Finally, the percentages of course offerings for each course grouping, academic level and LMHI knowledge area were computed from the tallies of each row and column.

5 Findings and discussion

The results of the analyses for each degree programme curricula, namely: the associate, baccaleaureate and masters programmes are presented in Table 4–6, respectively. While results of each table are discussed first, a comprehensive look into all three degree programmes is also examined. The results in Table 4 reveal that associate degree programme curricula have on average 58% of course offerings in the first year of study as opposed to about 42% in the second year. This programme seems to emphasise an understanding of the medical field, the development of communication skills and health information and data management in the first-half of the programme. This is evident from the first three sets of courses offered at the freshman-level. The second year's curricula, on the other hand, emphasise health information classification and coding, clinical experience and quality management. Surprisingly, little or no emphasis is laid on systems analysis and design, project management or on information privacy and security in all curricula for the associate degree programme.

Table 5 HIT programmes results for baccalaureate degree

Course offerings	*Freshman*	*Sophomore*	*Junior*	*Senior*	*Total*	*% Course*	*LMHI Area*
Communication skills in health informatics	44	18	15	2	79	5.54	Communication
Biology/anatomy and physiology	35	38	5	0	78	5.47	Knowledge management
Computers/information systems	20	16	13	7	56	3.92	Working clinical systems
Medical terminology/ pharmacology/ pathophysiology	15	20	51	14	100	7.01	Knowledge management
Health information/data management	13	36	66	64	179	12.54	Data quality/ management
Healthcare information systems	8	10	29	37	84	5.89	Working clinical systems
Health information coding	7	16	43	20	86	6.03	Working clinical systems
Management (general)	7	11	60	61	139	9.74	Knowledge management

Table 5 HIT programmes results for baccalaureate degree (continued)

Course offerings	*Freshman*	*Sophomore*	*Junior*	*Senior*	*Total*	*% Course*	*LMHI Area*
Quantitative methods/statistics	7	11	11	8	37	2.59	Secondary uses of data/information
Electronic health records	5	3	9	16	33	2.31	Knowledge management
Research/capstone project/ lab in health informatics	5	6	20	44	75	5.26	Knowledge management
Quality management/legal issues	3	13	46	52	114	7.99	Data quality/ management
Clinical experience/ practicum	3	12	31	10	56	3.92	Knowledge management
Health project management	0	0	0	6	6	0.42	Data quality/ management
Healthcare administration/ records handling	0	5	24	21	50	3.50	Clerical and service audit
Healthcare information privacy and security	0	0	1	2	3	0.21	Confidentiality and security
Systems analysis and design	0	0	5	14	19	1.33	Working clinical systems
Total	313	282	446	386	1427		
% at educational level	21.93	19.76	31.25	27.05			

Table 6 HI/HIT programmes results for master's degree

Course offerings	*Lower level*	*Upper level*	*Total*	*% Course*	*LMHI Area*
Health information/ data management	32	23	55	15.19	Data quality/ management
Computers/ information systems	32	28	60	16.57	Working clinical systems
Management (general)	20	9	29	8.01	Knowledge management
Biology/anatomy and physiology	14	13	27	7.46	Knowledge management
Quantitative methods/statistics	11	9	20	5.52	Secondary uses of data/info
Research/capstone project/lab in health informatics	10	29	39	10.77	Knowledge management
Medical terminology/ pharmacology/ pathophysiology	10	7	17	4.70	Knowledge management
Health project management	9	2	11	3.04	Data quality/ management

Table 6 HI/HIT programmes results for master's degree (continued)

Course offerings	*Lower level*	*Upper level*	*Total*	*% Course*	*LMHI Area*
Systems analysis and design	8	8	16	4.42	Working clinical systems
Quality Management/ legal issues	7	9	16	4.42	Data quality/ management
Healthcare information systems	6	7	13	3.59	Working clinical systems
Communication skills in health informatics	5	1	6	1.66	Communication
Healthcare information privacy and security	4	2	6	1.66	Confidentiality and security
Clinical experience/practicum	4	10	14	3.87	Knowledge management
Healthcare administration/records handling	2	4	6	1.66	Clerical and service audit
Electronic health records	1	2	3	0.83	Knowledge management
Health information coding	1	1	2	0.55	Working clinical systems
Total	189	173	362		
% at Level	52.21	47.79			

Overall, it can be said that while the first year is dedicated to introducing students to the medical field, and familiarising them with the necessary terminology and communication skills, the final year of the associate programme addresses health information coding and clinical practice above all else. Again, this seems to suggest that the associate degree programme takes a more or less practical and hands-on approach while the more theoretical topics like systems analysis and design and information security are treated with lesser emphasis.

Table 5 shows results of curricula at the baccalaureate level. Results for the freshman curricula are similar to those of the associate programme by emphasising on medical terminology and communication skills. However, at the sophomore level, the emphasis shifts towards anatomy and physiology, and health information and data management. In fact, the emphasis on information and data management stays consistent through junior and senior levels to yield the highest percentage score (12.54%) of all subject groupings. Another area of curricula emphasis through the junior and senior years, that is conspicuously noticeable, is quality management and legal issues with course offering average of nearly ten percent.

Overall, the first-half of the baccalaureates' degree programme seems to have the same focus areas as the associate degree programme. The major transition happens in the second-half of the programme. In this other half, management seems to be the major emphasis through the last two years: from general management to health information and data management, to quality management. Since most baccalaureate programmes' goal is to train health information managers at this level, this course distribution would suggest a logical path to take.

At the master's level (see Table 6), however, curricula emphasis showed a major shift. The top four areas of instruction were computers and information systems (16.57%); health data management (15.19%); research (10.77%) and management (8.01%). These findings suggest that the master's degree curricula leaned more towards understanding and interacting with systems, managing and troubleshooting these systems as well as being able to carry out research. It would seem students at this level were being trained to either pursue clinical or academic positions. Therefore, less attention was being placed on classification and coding of medical information probably due to the initial emphasis at the lower levels.

When these courses were further mapped to the LMHI framework and classified according to the *Meaningful Use* criteria stages, in the same way as seen in Table 1, the results generated were as shown in Figures 2–4. Two *LMHI* knowledge areas that garnered emphasis, irrespective of degree level, were data quality and management, and knowledge management. Aside from these two knowledge areas, each degree programme was unique in its third area of emphasis.

Figure 2 *LMHI* knowledge versus *Meaningful Use* criteria – associate degree programmes

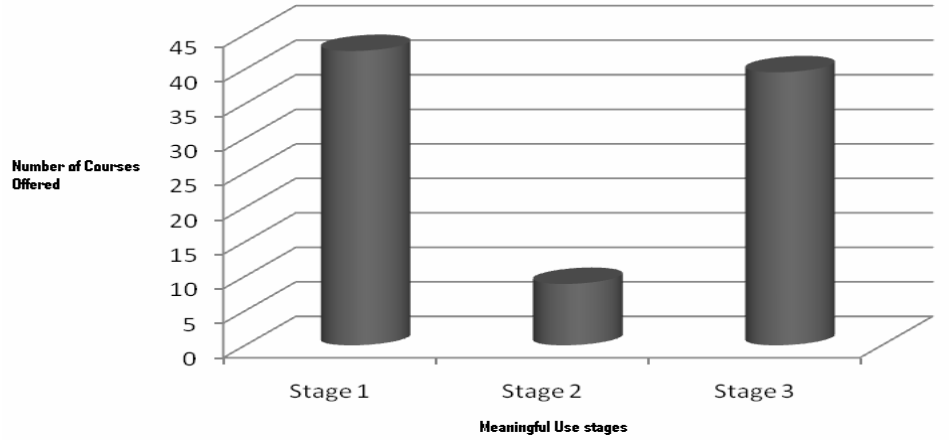


Figure 3 *LMHI* knowledge versus *Meaningful Use* criteria – baccalaureate degree programmes

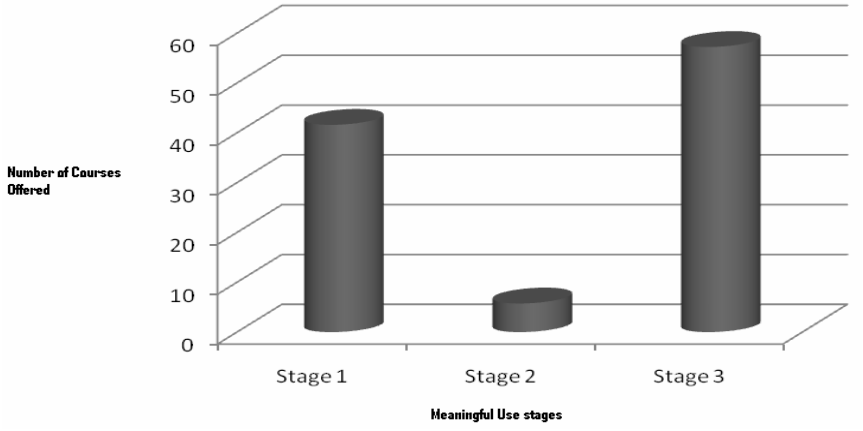
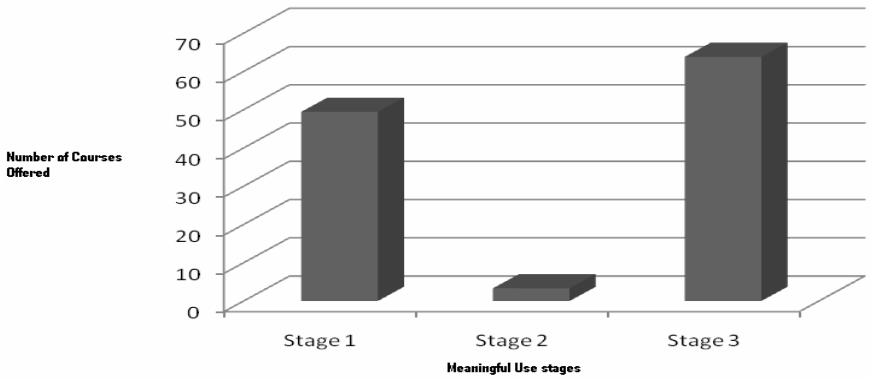
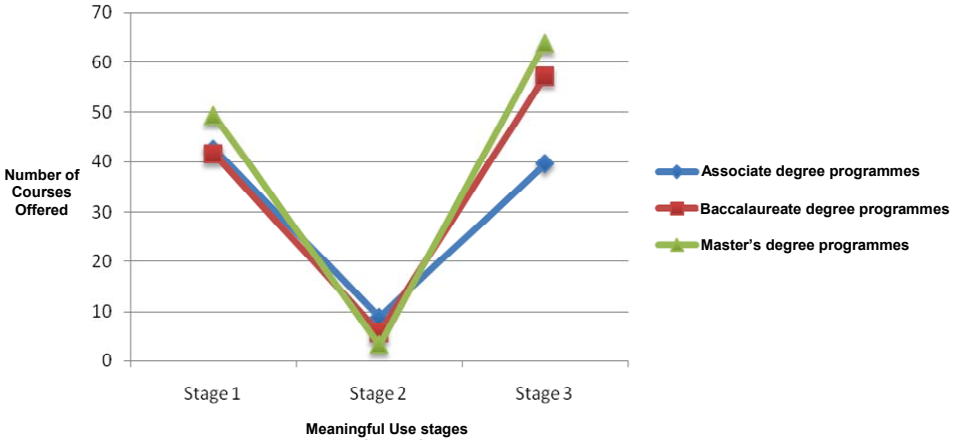


Figure 4 *LMHI* knowledge versus *Meaningful Use* criteria – master's degree programmes



Finally, the *LMHI* knowledge areas critical to *Meaningful Use Stage 1*, *Stage 2* and *Stage 3* were also measured and compared for each degree programme. Over 35% of instructional curricula, irrespective of degree programme, covered the *Meaningful Use* Stage 1 criteria objectives as shown in Table 1.

Figure 5 A comparison of degree programmes by *LMHI* knowledge area versus meaningful use stages (see online version for colours)



A general comparison across degree programmes (see Figure 5) revealed that all three degree programmes emphasis covered the critical *LMHI* knowledge areas for *Stage 1 Meaningful Use*. Apart from the telemedicine and telecare knowledge area, which could not be seen explicitly in the curricula, all the other seven knowledge areas were clearly covered. Also, it can be seen that while the undergraduate curricula addressed predominantly data-capture, graduate level curricula seemed to focus on decision-support, intelligence and systems development. *Meaningful Use Stage 2* was the least supported in terms of *LMHI* knowledge areas, while Stage 3 was well supported across the three degree programmes. It is likely that Stage 3 knowledge areas were significantly taught in all programmes because of the need for decision-support within the practice

site, rather than across different practices. However, emphasis on data-sharing and security were significantly low regardless of programme. This particular result suggests that there may be potential loop holes in the data-sharing phase of the *Meaningful Use* criteria if attention is not given to the knowledge areas that support this stage.

6 Conclusion

The results of this study on the US instructional curricula for health information technology professionals suggest that the first stage of the *Meaningful Use* is sufficiently covered across all three degree programmes. Since *Stage 1* is primarily concerned about data capture, results seem to point to the end that data capture at point of care might not be a major concern for the health information technology professionals in training under the current curricula. However, the minimal coverage of knowledge areas critical for Stage 2 of the *Meaningful Use* criteria means that there could be tremendous challenges ahead when the *data-sharing* phase begins in only some few years from now. The potential areas of concern, according to the findings from this study, will include communication and information security. Additionally, even though evidence from this study suggests that *Meaningful Use Stage 3*'s emphasis on intelligence for decision-making was being covered in the current curricula, the implementation of this stage may yield different result. Two reasons may account for this: first, great intelligence can only be built on excellent communication and information security; and second, Stage 3 of *Meaningful Use* will deal more with a regional- and national-level intelligence and decision-making, that it will be concerned with intelligence at the patient point of care. Lastly, with *Meaningful Use*, Stages 2 and 3 still at definition phases it may be difficult to predict now how these curricula would be effective in training *Meaningful Use* health information managers through the implementation of a *Meaningful curriculum*.

Using the Brittain and Norris's (2000) classification, the generic classifications used in this research were generally consistent. This conclusion is also consistent with a longitudinal study by Devaraj and Kohli (2000) on IT payoff in the healthcare industry. The study showed, for instance, that the impact of technology is contingent on business process reengineering practiced in these contexts. The implications here are that a change of curriculum will lead to a change in practice, which will then impact healthcare outcomes.

This research had some limitations. First, the data collection was completely based on information provided on institutional websites. Some of these websites, due to lack of updates, may not have fully reflected any recent changes in course offering or descriptions. Another limitation of this research is in the classification into generic groups, and the consequent mapping into the *LMHI* framework. In practice, there were courses whose description fell into more than one area of the generic classification. In such cases, the major emphasis of the course was chosen to be the main area of study. Some curricula were not very explicit, and lacked a proper description of the content matter. Given these limitations, research results should be interpreted with caution and in context.

Nevertheless, this research represents an important lens through which to look at the current context of transition in the US healthcare system in the area of professional and academic training. The findings are useful to curriculum developers who must tailor the training curricula to meet the goals of both policy and best practice. It also will benefit policy-makers in providing guidance for further decision-making and policy formulation.

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