

Design of an Innovative Double Degree Graduate Program in Health Informatics and Nursing: Bridging Nursing and Health Informatics Competencies

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Abstract

This article describes a novel double-degree Master's program in Nursing and Health Informatics. The program was designed to prepare nurses with graduate level competencies in both nursing and health informatics. Such competencies are essential for professionals working in the rapidly expanding fields of nursing and health informatics. There is an immediate and longer-term need for clinical professionals with such expertise in Canada. Furthermore, a program was needed to provide graduate level credentialing in nursing and health informatics so graduate students could develop needed workplace competencies at the intersection of nursing and health informatics in the international move towards electronic health records.

The double-degree program described in this paper is the first of its kind. The design, underlying rationale, and initial experiences with the program are described in detail in this paper.

Keywords

nursing informatics, health informatics, biomedical informatics, medical informatics, nursing informatics education, nursing education, health informatics education, competencies, curricula

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1 Introduction

There is an increasing need for well qualified health informatics specialists who possess clinical skills as well as health informatics knowledge, skills and judgment. Indeed, in many efforts to deploy complex health information systems (HISs) throughout the world, it has been reported that a major stumbling block has been a lack of professionals who understand the complexities of HISs (such as electronic health records - EHRs) and the health-care settings where they are deployed.

To address these issues, the Schools of Health Information Science and Nursing at the University of Victoria collaborated to design a Masters program that allows students to graduate with two degrees – one in health informatics and one in nursing. The Masters program is designed to bridge competencies in the two domains.

The School of Health Information Science is an educational organization which has offered degree programs in health informatics for thirty years and is recognized for its teaching, research and consultancy in health informatics [1]. The School of Nursing at the University of Victoria is recognized for its innovative delivery of education, in particular distance models for delivery of programs.

This paper describes the design of a new double-degree program in Nursing and Health Informatics. It begins with a discussion of the background to the program's development followed by related graduate programs. This discussion is followed by the description of the health and human resource issues that have influenced this program's development, along with a description of the program curriculum and course structure. The paper concludes with an overview of the experiences to date and lessons learned in the program's implementation.

2 Background to Bridging Nursing and Health Informatics Education

Over that last twenty years we have seen a considerable rise in the implementation and use of health information systems (HISs) and information and communication technologies (ICTs) in healthcare globally. Many countries are currently implementing HISs and ICTs in an effort to streamline healthcare delivery, reduce medical errors and improve the overall quality and efficiency of healthcare services (e.g. United States, countries of the European Union and Canada) [2, 3, 4, 5]. In Canada, Canada Health Infoway [6] has been working with federal, provincial and territorial governments to implement HISs that would lead to a pan-Canadian EHR, or repository of electronically-maintained information about a patient's health status and healthcare that can be used by patients and healthcare professionals involved in their care [5, 6, 7]. Such a large scale deployment of HISs and ICTs is not possible without a substantive, formally educated workforce in the discipline of health informatics [5, 8, 31].

In Canada, health informatics is considered to be the field that deals with information processing (including computers) and communication in healthcare practice, disease prevention, education and research [8]. This includes not only access to health related information electronically by healthcare workers, but also by the general public and patients (e.g. use of Web-based health information resources to access health information) [7]. The sub-fields of health informatics include bioinformatics, imaging informatics, public health informatics, educational informatics and clinical informatics (of which nursing and medical informatics are a part) [5, 9].

Health informatics professionals are responsible for designing, developing, implementing, evaluating, and maintaining HISs in a wide array of healthcare settings [7, 8, 9]. According to Canada's Health Informatics Association (COACH), health informatics professionals must have information, clinical and management science competencies to be successful in the field of health informatics [8]. Many of these competencies overlap with those outlined by the International Medical Informatics Association's (IMIA) work on education in biomedical and health informatics [9]. These competencies also take into account the local, Canadian historical developments in the fields of health informatics and nursing education and are reflective of the regional health authority, government and industry sectors that employ health informatics professionals [8].

2.1 Defining Health and Nursing Informatics in Canada

Historically, health informatics has been an interdisciplinary field—drawing researchers and professionals from differing domains of practice (e.g. computer science,

medicine, nursing, management, library science). Health informatics professionals drew on knowledge and research from these fields to inform their practice. Over the last twenty years, health informatics has emerged as a separate discipline developing its own body of knowledge that is contributing to its own growth as a discipline as well as contributing knowledge back to the disciplines from which it originated (e.g. computer science, medical science, nursing science and library science) [5, 8]. As a consequence, health informatics professionals in Canada require information, clinical, and management science competencies. Health informatics professionals need these core competencies to have the knowledge, skills and judgment to effectively implement and maintain HISs [8].

The Canadian Nursing Informatics Association [10] draws on the work of Staggers and Bagley-Thompson's [11] in defining nursing informatics in Canada. They identify that:

"nursing science, computer science, and information science are used to manage and communicate data, information, and knowledge in nursing practice. Nursing informatics facilitates the integration of data, information, and knowledge to support clients, nurses, and other providers in their decision-making in all roles and settings." [11].

In summary, nursing informatics can be considered a discipline-specific form of informatics practice within health informatics. Nursing informatics borrows from nursing science, computer science, information science and nursing practice to support nurses, other healthcare providers and patients (including information structures and processes).

2.2 Related Graduate Programs

Internationally, a number of biomedical, health and nursing informatics programs have been developed and implemented in varying countries around the world. In the area of nursing informatics, there are a number of nursing schools that offer students a Masters in nursing with a specialization in nursing informatics; for example, the University of Maryland [12] and the University of Utah [13]. Efforts in nursing informatics in Europe have included projects such as NIGHTINGALE which have focused on implementing strategy for training nurses to apply and use HISs [14]. In the area of biomedical informatics, there have been a wide range of programs emanating from medical and computer science/informatics schools. For example, in North America there are masters programs in biomedical informatics such as those offered by Columbia University [18], Arizona State University [15], Oregon Health and Science University [16] and Washington State University [17]. In Europe there have been several pioneering medical, biomedical and health informatics Masters programs, a number of them predating those in North America such as the Medical Informatics Program at Heidelberg/Heilbronn in Germany that

was founded in the 70's [33]. Other health and biomedical informatics programs can be found in the Netherlands [19, 20], Austria [21], Spain [22] and other European countries [23, 29]. Extensions of this work has included the EuroMISE project which involved 20 universities, research institutions and companies and created a teaching network of higher education institutions focusing on medical informatics, medical statistics and epidemiology [24]. Programs designated as health informatics masters have also appeared worldwide, including those in Saudi Arabia [25], Peru [26] and Canada [7]. Many of these health informatics programs have focused on competencies and have been influenced by curricula recommendations released by IMIA [14].

Despite the number of health and biomedical informatics related programs, in reviewing the published literature describing innovations in graduate education in the area, we were unable to find any programs that provide students with a Masters of Nursing (MN) and a Masters Science (MSc) in Health Informatics upon completion. At the University of Victoria, we have observed a demand for trained professionals that have competencies in both nursing and health informatics (as described in the next section on Health and Human Resource Issues). Furthermore, the University of Victoria, having both a School of Health Information Science and Nursing, allowed for the opportunity to explore the creation and implementation of a new type of program that was designed to integrate training, leading to the full list of competencies at the graduate level for nursing and health informatics. Given the current world-wide landscape regarding related programs and the observed Canadian workforce needed to develop graduates with dual competencies (as described in the next section) we embarked on the creation of the new double degree program described in this paper.

2.3 Health and Human Resource Issues

In Canada the need for skilled health informatics professionals is significant [31]. According to statistics published in 2008, only 2.4% of Canadian hospitals have a full electronic patient record [32]. 97.6% of hospitals [32] use both paper and electronic records (i.e. hybrid environments) to record patient information [26, 27]. As well, up to 60% of physicians still use paper patient records in their offices. The Canadian government recently funded Canada Health Infoway, the organization that has spearheaded the use of EHRs, another 500 million dollars (after an initial billion dollar investment) to continue its work in the area of EHR implementation [6].

Canadian estimates indicate there is a shortage of qualified health informatics professionals [8]. A published report identified that there is a need for 8,490 health informatics professionals over the next 5 years with an additional 32,170 individuals who are working in the health informatics field requiring skill broadening to include the health informatics competencies necessary to work in the area as outlined by COACH [8, 31].

In terms of nursing, at the time the current program was being developed there were no Masters of Nursing programs that prepared graduates with a specialization in nursing informatics in Canada. There were only a few post-graduate certificate programs and standalone courses [8, 10]. Therefore, even if the existing health informatics programs attempted to increase their student output, there would still be a severe shortage of health informatics professionals well into the future [8, 28, 29, 30, 31].

The program described in this paper grew out of a response to current and future needs for health informatics professionals in Canada. More specifically, there is a need for health informatics professionals that can support current implementation and future use of EHRs. It is anticipated that healthcare records in all major institutions (i.e. hospitals, home care agencies, clinics and physician offices) will become paperless. Canada's institutions are moving away from hybrid (paper-electronic EHRs) to full EHRs [27]. These EHRs require updating to reflect advances in clinical practice, administrative work and technological advances. EHRs necessitate a major shift in healthcare practice and the need to develop experts to support that practice. As a consequence, the objective of the new program is to prepare graduates to be at the forefront of health informatics in Canada and internationally.

A double-degree program was designed because individuals experienced in healthcare practice, medical/nursing terminologies and institutional culture who are also experts in computerized technologies are needed to guide other health professionals in these new practice demands [8, 31, 34]. Professional nurses are in a unique position to become leaders in this field once they obtain the necessary foundational knowledge and familiarity with advanced or graduate level nursing and health informatics practice. Currently, there are many nurses nationwide who are implementing EHRs. There are also many nurses who are members of the Canadian Nursing Informatics Association. The majority of nurses working in nursing/health informatics roles hold bachelor's degrees in nursing. Some hold graduate degrees that are clinically or administratively focused (i.e. focusing on clinical aspects of nursing or health services administration/policy). These individuals were the initial target audience for this program – the program would provide them with opportunities to broaden and/or develop graduate level nursing and health informatics competencies.

The infrastructure for the double degree program already existed in the Faculty of Human and Social Development at the University of Victoria. The School of Nursing has offered the Masters of Nursing (MN) degree, with a current enrolment of nearly 200 students. The School of Health Information Science has offered a Master of Science (MSc) in Health Informatics since 1990, with a current enrolment of approximately 90 students. While MN programs are offered at many universities throughout the country, the School of Health Information Science at the University of Victoria is the only School in Canada de-

voted to health informatics and offers the only distance MSc in Health Informatics in Canada. The University of Victoria had a unique opportunity to offer a double-degree program in these areas as there is expertise in both domains that is not readily available in any other location in Canada.

3 Aims, Goals, and Objectives of the Double-Degree Program

3.1 Distinctive Characteristics

The double-degree program was designed to offer baccalaureate-prepared nurses the opportunity to develop advanced practice competencies in two fields, creating an exciting career pathway. The program was designed so that an MN and MSc in Health Informatics could be completed in three years, where two separate degrees would take four years.

Further, the double-degree program is designed to provide the opportunity to engage in two distinct but related fields simultaneously and in an integrated manner. To complete the program, students take both degrees concurrently. In addition, the program was designed to be offered online through distance and distributed learning technologies (using Moodle® and Blackboard Collaborate®). The intent was to make the program accessible to students throughout Canada and beyond.

Typically, a new program requires substantial resources for program development and implementation. However, this double-degree program took advantage of existing programs, existing courses, and resources already available to MN and MSc Health Informatics students. In addition, this new program was complementary to the university's current programs as it provided interdisciplinary opportunities not only to the students in the double-degree program but to all graduate and undergraduate nursing and health informatics students, through elective courses, seminars, research collaborations, and other forms of scholarship.

3.2 Program Goals

The goal of the double-degree program is to prepare advanced practice nurses for careers at the intersection of nursing and health informatics, thus the overarching goal is to produce graduates who are qualified to work in a wide range of roles, including consulting roles, analyst positions, management roles (i.e. directors and chief information officers) and specialists in clinical informatics across Canada and abroad.

The faculty developing and delivering the program believe that nurses possessing the requisite health informatics background will be particularly sought after for key

leadership roles in promoting and disseminating HISs. The program also prepares students to pursue further doctoral work in either nursing or health informatics.

Currently, there are many nurses who are members of the Canadian Nursing Informatics Association and who are already working in health informatics. Many nurses have expressed a desire to advance their knowledge and skills at the intersection of nursing and health informatics (and this number is rapidly growing). In fact, currently there are many more health informatics professional work opportunities than health informatics positions in Canada and abroad). These positions are in regional health authorities, hospitals, HIS vendors, consulting companies, federal and provincial governments and health information organizations (e.g. Canadian Institute for Health Information). There is a major demand for appropriately trained graduates to design and implement EHRs and this demand is continuing to increase.

4 Curriculum Design

The double-degree curriculum follows the curriculum design of each degree (i.e. the Masters of Nursing and the Masters in Health Information Science). Each student entering the program must be a Registered Nurse with a Bachelor of Science in Nursing degree and (generally) with at least two years of clinical practice experience to enter the program. The admission requirements are the same as for the individual nursing and health informatics programs (i.e. students must fulfill the requirements for entering a Masters in Nursing, as well as the requirements for entering a Masters in Health Information Science program) with the addition of a pre-requisite undergraduate-level statistics course for students. Applicants are also expected to have obtained at least two years of relevant work experience before applying (e.g. working as an intensive care nurse or a community health nurse) and complete a research thesis.

Each student takes advanced Nursing courses and a series of courses in Health Informatics. The Nursing courses taken are the nursing graduate core classes in philosophy, theory and methodology, plus a course on issues and two electives. The health informatics courses to be taken are those in HIS, an overview of health informatics, database design, and research, plus two electives supporting students' career goals. The course sequence is a three-year program designed for full-time students. Each year requires coursework in both disciplines. Table 1 lists the curriculum sequence for the double-degree program.

In addition each student completes two experiential learning or cooperative (Coop) education experiences that give them work experience in one placement that is specifically nursing/clinical informatics related and another placement in a more general health informatics setting. The cooperative education experiences are planned within the existing structure of the School of Health Information Science. Students are expected to develop health informa-

tics competencies and to also demonstrate the ability to apply advanced nursing concepts to practice.

A research based thesis is required. Students enroll in a thesis seminar class at the end of the 2nd year of the program and will have one calendar year in which to develop and execute the thesis project. The supervisory committee consists of two faculty co-supervising students, one from each discipline (nursing and health informatics). The faculty supervisor from health informatics provides expertise from his or her field of research and work (e.g. human factors in healthcare, organizational behavior and change management, patient safety). The faculty supervisor from nursing provides expertise from a clinical and advanced nursing practice perspective. As the supervisors have regular contacts with their students each term in these two programs, the integration of the disciplines is evaluated as the student progresses.

4.1 Schedule of Course Delivery

It should be noted that the reason that coursework in both disciplines is required in each year is that the student is expected to simultaneously apply the concepts/theories and competencies from each discipline to the other throughout the double degree program (see Table 1). Students taking a nursing theory class are directed to apply the theory to the practice of health informatics. Likewise students taking a health information systems course will be directed and guided to reflect on information systems in the practice of nursing.

A total of 2 Nursing electives and 2 Health Informatics electives are required.

Electives are chosen in consultation with student's supervisors from nursing and health informatics (see below).

Health Informatics electives:

HINF 561	Project Management
HINF 551	Electronic Health Record
HINF 511	Clinical Decision Support Systems
HINF 560	Health Care Quality Improvement
HINF 573	Applied Biostatistics
HINF 575	Human Factors in Healthcare
HINF 510	Information Management and Technology
HINF 562	Procurement in Health Informatics
HINF 591	Ethical and Legal Aspects of Health Informatics (Special Topics)

Nursing electives:

NURS 503	Qualitative Approaches to Research in Nursing
NURS 504	Phenomenology and Hermeneutics Approaches to Inquiry
NURS 514	Nursing Ethics for Leadership and Practice
NUNP 531	Applied Pathophysiology

NUNP 532	Pharmacology Interventions in Health and Illness
NUNP 540/541	Advanced Assessment and Diagnostic Reasoning
NUED 570	Engaging with Pedagogy: Teaching and Learning in Nursing Education

4.2 Delivery Methods

The program begins with an onsite initial orientation to the nursing and health informatics programs. In the School of Health Information Science this consists of a half-day non-credit orientation to the School, its resources, the library, the educational tools used in the program, the faculty, an overview of the health informatics courses is provided and thesis requirements. The Nursing orientation is a general, three-day orientation for all students in the distributed MN program. It is non-credit, and the only time students are required to be on campus for the duration of their program. The orientation includes an introduction to the graduate nursing program, time to meet with faculty advisers, an introduction to MN core courses and an introduction to online learning tools.

All courses are delivered through online distance learning technologies (e.g. Blackboard Collaborate®, Moodle®), supplemented with an orientation to each of the three years. The experiential or cooperative learning experiences are in locations throughout Canada. Each experiential or cooperative education experience will be 455 hours in length. (Note: all courses are currently taught online and both School's faculty are experienced with this delivery method).

4.3 Learning Outcomes, the Curriculum Design and Competencies

4.3.1 Master of Nursing Degree

The learning outcomes for the Master of Nursing program have been documented in the establishment and the delivery of the Master of Nursing degree. The program goals for the Master of Nursing program are that the graduates:

1. Develop advanced knowledge in nursing complemented by knowledge from other sciences and bodies of knowledge.
2. Develop in-depth knowledge related to a particular area, context of population of practice.
3. Be critically-reflective practitioners.
4. Develop a focused vision of advanced nursing practice.
5. Provide leadership and direct care in advanced practice roles.

Table 1: Master of Nursing (MN) and Master of Science (MSc) in Health Informatics Double-degree [Full time (3+ years)] (NURS = nursing course; HINF = health informatics course; NUHI = nursing and health informatics).

Year 1		
September-December	January-April	May-August
NURS 506 Philosophical Knowledge & Advanced Practice Nursing	NURS 507 Theoretical Knowledge & Advanced Practice Nursing	NURS 508 Methodological Knowledge & Advanced Practice Nursing
HINF 572 Health Informatics: An Overview	HINF 550 Health Information Systems Design	Coop or Experiential Nursing Experience
	HINF 501 Database Design	
Year 2		
September-December	January-April	May-August
HINF 503 Research Methods in Health Informatics	Coop or Experiential Nursing Experience	NURS 565-566-567 Trends and Issues in Advanced Practice Nursing
HINF Elective		NURS Elective
HINF Elective		NURS 593 or HINF 580 Thesis/Project Seminar
Year 3		
September-December	January-April	
NURS Elective	NUHI 599 Thesis [until completion]	
NUHI 599 Thesis		

6. Contribute to knowledge development.
7. Develop and support "best practices".
8. Negotiate and manage change.

Table 2 illustrates the other learning outcomes and the courses/activities/content that supports the student in achieving the expected nursing outcomes. Courses that support each of the learning goals stated are illustrated in Table 2.

4.3.2 Masters of Science in Health Informatics Degree.

The learning outcomes for the Masters of Health Informatics degree are consistent and reflective of the expected competencies for the field as outlined by the health informatics professional organizations in Canada and IMIA [8, 9]. More specifically, the students are expected to develop advanced competencies in the following areas of health informatics:

1. the health sciences,
2. the information sciences,
3. the management sciences,
4. research.

For double degree students (i.e. health informatics component) the focus could be on one of a number of areas of practice in health informatics (see Table 3 sections - health science, information science and management science competencies in health informatics). Table 3 provides learning goals and the courses/Coops/thesis that support students achieving the expected health informatics outcomes.

5 Current Status and Experiences to Date

Developed over a two year period (i.e. 2008-2009), the Masters of Nursing and Health Informatics Program received approval from the British Columbia Ministry of Education in 2010. The program's first intake was in the Fall of that year. The initial pilot intake consisted of five students. In the Fall of 2011, nine more students were admitted to the program for a current total of 14 students. In the Fall of 2011, the Schools received approximately 30 applications to the double degree program.

The program is growing rapidly and is of interest to nurses pursuing graduate studies. The program has attracted nurses from across Canada who have an interest in pursuing graduate studies in both nursing and health informatics. The double degree students have integrated well with traditional nursing graduate students (when taking graduate level nursing courses) and

Table 2: Nursing Learning Goals and Courses.

Learning Goal	Course
Advanced knowledge	NURS 506 Philosophical Knowledge & A.P. Nursing NURS 507 Theoretical Knowledge & A.P. Nursing
Critical reflection in practice	NURS 506 Philosophical Knowledge & A.P. Nursing Nursing Coop
Vision of advanced nursing practice	NURS 507 Theoretical Knowledge & A.P. Nursing
Leadership and direct care	Nursing Coop
Knowledge development	NURS 508 Methodological Knowledge & Advanced Practice Nursing Thesis
"Best practices"	NURS 508 Methodological Knowledge & Advanced Practice Nursing NURS 565 Nursing Issues
Negotiate/ manage change	Nursing Coop NURS 565 Nursing Issues

Table 3: Health Informatics Learning Goals and Courses.

Learning Goal	Course
An general overview of the field.	HINF 572: Health Informatics: An Overview
Advanced competencies in Health Sciences	HINF 511: Clinical Decision Support Systems HINF 551: Electronic Health Record Thesis HINF Coops
Advanced competencies in Information Sciences	HINF 550: Health Information Systems Design HINF 591: Database Design HINF 551: Electronic Health Record HINF 561: Project Management HINF 575: Human Factors in Healthcare HINF 591: Ethical and Legal Aspects of Health Informatics Thesis HINF Coops
Advanced competencies in Management Sciences	HINF 561: Project Management HINF 560: Health Care Quality Improvement HINF 510: Information Management and Technology HINF 562: Procurement in Health Informatics HINF 591: Ethical and Legal Aspects of Health Informatics Thesis HINF Coops
Advanced competencies in Health Informatics Research	HINF 503: Research Methods in Health Informatics HINF 573: Applied Biostatistics Thesis HINF Coops

health informatics students (who have undergraduate backgrounds in health informatics, computer science, engineering, medicine, other allied health disciplines and health services management).

Graduate student supervision follows existing policies within two Schools. Students are currently deciding upon potential thesis topics at the intersection of both disciplines and identifying potential supervisors from nursing

and health informatics (i.e. as one faculty from each program is expected to co-supervise each student).

Many employers who have hired health informatics undergraduate and graduate students for cooperative learning or experiential learning work opportunities have expressed a desire to not only hire undergraduate and graduate students, but double degree students. Some employers expressed a specific interest in hiring individuals

who have both nursing and health informatics competencies at the graduate level – cooperative education providing them with a opportunities to hire such individuals while they are still undertaking their studies. A number of employers identified a significant need for nurses who have competencies in both these areas (i.e. nursing and health informatics). Several employers (e.g. regional health authorities) rapidly identified positions in their organizations where there is a need for such individuals with such a unique set of abilities upon learning about the program. These positions have roles and responsibilities that are typical of job descriptions where health informatics professionals were asked to act as clinical analysts, clinical informatics specialists, nursing informatics specialists, research analysts, trainers and clinical informatics coordinators as outlined by the health informatics professional organization in Canada [34].

During cooperative learning experiences, students have identified they have encountered a general lack of understanding of the dual role of nurse-health informatics professional. Students have also reported that neither the information management nor the information technology staff understand that a student can have both skill sets at the graduate level (i.e. in nursing and health informatics). Although this was an initial educational challenge for students, once employers learned of and recognized students skills, they moved students into liaison roles between clinical and health informatics departments, and between system developers, implementers of information and communication technologies and end-users. Future work for faculty will include developing strategies to ease the transition for double degree students and employers (e.g. providing additional information about student's backgrounds and training/resources for employers to learn more about double degree student nursing and health informatics knowledge and skills).

A formal evaluation of the program is currently in the planning stages. Each of the Schools has continued with their existing program assessment plans as mandated by the University. An evaluation committee of faculty representing both programs has been formed to assess the combined evaluative data and to track alumni progress in the field after graduation.

6 Discussion

In summary, a partnership between the Schools of Nursing and Health Information Science at the University of Victoria, Victoria, British Columbia has led to the design and development of a new double degree program leading to a Masters in Nursing and Health Informatics. The three year distance education program relies on interleaving classroom learning and cooperative education or experiential learning experiences involving work on real-world HIS projects to solidify learning at the intersection of these two fields. There has been a significant and enthusiastic response to the launch of this program that

links classroom to experiential learning by Baccalaureate prepared nurses who are interested in careers in nursing informatics and employers who are seeking out individuals with expertise in advanced practice nursing and health informatics.

Although challenges have been encountered in aspects related to initial course coordination, placement and integration of students in required cooperative work experiences, the program is now well underway. Furthermore, we are expecting increases in enrollments as the program continues into the future. We are continuing to obtain feedback from students, faculty and employers (through our cooperative education program) in order to fine-tune and iteratively update the program to address student learning needs and health and human resource issues in Canada.

Masters of Nursing programs do exist throughout Canada and are offered internationally. Furthermore, there are a variety of Biomedical and Health Informatics educational programs offered internationally. However, publications describing the design and implementation of a double degree program in nursing and health informatics have not been previously reported in the peer reviewed literature. To the best of our knowledge the double degree program in nursing and health informatics is the first of its kind, with the objective of combining the full competencies and strengths from two disciplines - nursing and health informatics. Furthermore, through integrating competencies from both nursing and health informatics, the double degree program is the first degree program to offer nurses both nursing and health informatics training at the graduate level in Canada.

References

- [1] Kushniruk, A.W., Lau, F., Borycki, E., Protti, D. (2006). The School of Health Information Science at the University of Victoria: Towards an Integrative Model for Health Information science Education and Research. In Yearbook of International Medical Informatics, 159-165.
- [2] Andersen, S. K., Klein, G. O., Schulz, S., Aarts, J. Mazzoleni, M. C. (2008). Ehealth beyond the horizon - Get IT there. Washington, D.C.: IOS Press.
- [3] Lau, F. (2001). Health informatics education in Canada - What's Ahead? *Electronic Healthcare*, 1(2), 46-51.
- [4] Protti, D. (2008). Adoption of information technology in primary care physician offices in New Zealand and Denmark, part 2: Historical comparisons. *Informatics in Primary Care*, 16, 189-93.
- [5] Shorliffe, E. H. Cimino, J. J. (2006). *Biomedical informatics: Computer applications in health care and biomedicine*. New York: Springer Verlag.
- [6] Canada Health Infoway (2009). The Infoway approach. Accessed at <http://www.infoway-inforoute.ca/lang-en/about-infoway/approach> (2009-04-05).
- [7] Kushniruk, A. W. Borycki, E. M. (2008). *Human, social and organizational aspects of health information systems*. Hershey Pennsylvania: Idea Group.

- [8] Canada's Health Informatics Association (COACH) (2009). Health informatics professional core competencies. COACH: Toronto.
- [9] Mantas, J., Ammenwerth, E., Demiris, G., Hasman, A., Haux, R., Hersh, W., Hovenga, E., Lun, K. C., Marin, F., Martin-Sanchez, F., Wright, G. (2010). Recommendations of the International Medical Informatics Association (IMIA) on Education in Biomedical and Health Informatics: First revision. *Methods of Information in Medicine*, 49, 105-120.
- [10] Canadian Nursing Informatics Association (2011). Nursing informatics. Accessed at <http://www.cnia.ca/intro.htm> (2011-06-15).
- [11] Staggers, N. Bagley-Thompson, C. (2002). The evolution of definitions for nursing informatics. *JAMIA*, 9(3), 255-261.
- [12] Hinegardner, P. G., Lansing, P. S. (1994). Nursing informatics program at the University of Maryland at Baltimore. *Bulletin of the Medical Library Association*, 82(4), 441-443.
- [13] Hilz, L. M., Thompson, C. B. (2000). Expanding horizons in nursing: The clinical informatics graduate program. *Online Journal of Nursing Informatics*, 4(1), 1-16.
- [14] Mantas, J. (1998). Developing curriculum in nursing informatics in Europe. *International Journal of Medical Informatics*, 50, 123-132.
- [15] Greenes, R. A., Panchanathan, S., Patel, V., Silverman, H., Shortliffe, E. H. (2008). Biomedical informatics in the desert: A new and unique program at Arizona State University. *IMIA Yearbook*, 150-153.
- [16] Valerius, J. D., Hersh, W. R. (2008). How well a biomedical informatics curriculum map to health information management knowledge clusters? Analysis of a program.. *AMIA Annual Symposium Proceedings*, 697.
- [17] Demiris, G. (2007). Interdisciplinary innovations in biomedical and health informatics graduate education. *Methods of Information in Medicine*, 46, 63-66.
- [18] Passareli, K. H. (2004). IT IQ in varying degrees: Growing number of universities offering executives intensive education, distance learning in the field of biomedical informatics. *Modern Healthcare*, 24(43), 1-4.
- [19] Goossen, W. T. F. (1996). Overview of health care and nursing informatics in the Netherlands. *Health Informatics Journal*, 2, 9-20.
- [20] Van Bommel, J. H. (2006). Assessment of education and research in biomedical informatics. *IMIA Yearbook of Medical Informatics*, 5-10.
- [21] Haux, R. (2004). Biomedical and health informatics education at UMIT – approaches and strategies at a newly founded university. *International Journal of Medical Informatics*, 73, 128-128.
- [22] Lopez- Campos, G., Lopez-Alonzo, V., Martin-Sanchez, F. (2010). Training health professionals in bioinformatics. *Methods of Information in Medicine*, 49, 299-304.
- [23] Hasman, A., Albert, P., Wainwright, R., Klar, R., Sosa, M. (1995). Education and training in health informatics in Europe: State of the art. IOS Press.
- [24] Zvarova, J. (2006). Biomedical informatics research and education at the EuroMISE Centre. *IMIA Yearbook of Medical Informatics*.
- [25] Altuwajri, M. M. (2010). Supporting the Saudi e-health initiative: The Master of Health informatics program at KSAU-HS. *Eastern Mediterranean Health Journal*, 16(1), 119-124.
- [26] Curioso, W. H., Fuller, S., Garcia, P. J., Holmes, K. K., Kimball, A. M. (2010). Ten years of international collaboration in biomedical informatics and beyond: The AMAUTA program in Peru. *JAMIA*, 17, 477-480.
- [27] Borycki E. M. Lemieux-Charles, L. (2009). Does a hybrid electronic-paper environment impact on health professional information seeking? *Studies in Health Technology and Informatics*, 136, 505-10.
- [28] Covvey, D. H., Kushniruk, A., Fenton, S. (2005). The state of health informatics education in Canada. *HCIMC*, 2. Accessed at http://www.hccinc.com/bcovers/previous/Vol_XX_No_2/pdfs/Covvey_Kushniruk_Fenton.pdf (2009-04-05).
- [29] Diomidus, M., Mantas, J. (1998). Assessing the progress of the MSc course in health informatics under the ERASMUS programme, *International Journal of Medical Informatics*, 50, 159-163.
- [30] Roach, R. & Covvey, D. (2007). Co-operative experience in health informatics. Presented at COACH's Recruiting and Retaining HI Professionals Conference.
- [31] COACH (2009). Canada's Health Informatics and Health Information Management Human Resources Report. COACH: Toronto.
- [32] Urowitz, S., Wiljer, D., Apatu, E., Eysenback, G., DeLenardo, C., Harth, T Eysenbach, G. (2008). Is Canada ready for patient accessible electronic health records? A national scan. *BMC Medical Informatics and Decision Making*, 8, 1-7.
- [33] Knaup, P., Haag, F. J., Leven, H., Dickhaus, H. (2009). Challenges in the evolution of the medical informatics program at Heidelberg/Heilbronn (Germany). *Methods of Information Medicine*, 48, 66-75.
- [34] Canada's Health Informatics Association (2010). Health informatics professional career matrix. Canada's Health Informatics Association: Toronto.