HIGHER EDUCATION STRATEGY ASSOCIATES

MONITORING TRENDS IN **ACADEMIC PROGRAMS**

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HESA Presents

ABOUT HESA

Monitoring Trends in Academic Programs

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ABOUT THE COMPANY

Higher Education Strategy Associates (HESA) is a Toronto-based firm providing strategic insight and guidance to governments, postsecondary institutions, and agencies through excellence and expertise in policy analysis, monitoring and evaluation, and strategic consulting services. Through these activities, HESA strives to improve the quality, efficacy, and fairness of higher education systems in Canada and worldwide.

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INTRODUCTION TO MONITORING TRENDS

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WELCOME

This is the second in Higher Education Strategy Associates' ongoing series, Monitoring Trends in Higher Education. The FIRST EDITION focused on some key trends in the Social Sciences and Humanities , including the growth of service learning and the burgeoning importance of multi-disciplinary studies. This second edition traces the emergence of these themes in the health sciences, where new programs and disciplines are endeavouring to bring medical innovations and knowledge to wider audiences. It explores programming that intersects different fields, developing new knowledge and ways to analyze and understand the growing datasets available to health researchers. It is also intended to provide some information about program trends outside Canada.

As with all editions in this series, this report is not designed to be a comprehensive documentation of every relevant program in these areas in Canada (or, indeed the world). There is a particular focus on new programs—that is, programs that have received accreditation within the last decade. This document also focuses primarily on university programs, though there is some consideration of programming at colleges and polytechnics in the health informatic field. A future edition focused on some key developments in colleges and polytechnics is planned.

In this edition's three sections, we explore the intersection between health sciences and a variety of other fields:

- ***BIOMEDICAL ENGINEERING*** explores programs that incorporate anatomy, engineering, biochemistry, physiology, and different biological fields (such as cellular biology), The number of biomedical engineering programs has grown in Canada and features an array of industry and research orientated programs.;
- ***HEALTH AND THE PUBLIC SPHERE*** considers developments in public health, which is a relatively venerable field but one that has undergone some important developments in terms of concentrations, learning outcomes, and accreditation; and
- ***HEALTH INFORMATICS*** focuses on health informatics, a field that has been expanding in Canada since the 2000s and draws together knowledge from health science, computer science and business management. It also focuses on the emergence and proliferation of Bioinformatics programs as the sheer size of data sets for health sciences grows exponentially.

Another theme in this edition is the role of external agencies in shaping academic programming. As many of these programs are orientated towards roles that improve public health, there are accreditors and other external bodies that seek to provide standardized guidance for the sorts of learning outcomes and strengths that graduates should possess to succeed in a range of careers.

While this version of Monitoring Trends is focused on specific disciplines, many of the trends discussed here apply to a wide range of fields beyond the health sciences. Much can be learned from the growth of these programs that cut across disciplinary fields and bring together different evidence bases and approaches to ask new questions and develop new insights.

Note: a bibliography of works cited is available on request.

BIOMEDICAL ENGINEERING

Biomedical Engineering programs have existed for decades, often as Clinical Engineering programs. It was among the first fields that brought together different disciplines and approaches from both the life sciences and engineering.

The field gradually expanded outward from a focus on medical devices and electrical safety at clinics to encompass a vast range of activities around device design, physiologic systems modeling, developing new artificial organs, and other pursuits (Bronzino, 2005).

In Canada, the first program with the "Biomedical Engineering" title was established at l'Université de Montreal, in 1970, followed by the University of Alberta (1982), and McGill (1989). In recent years we have seen a proliferation of new programs in the field, including a bachelor's program at Waterloo (2013), a Bachelor's in Integrated Biomedical Engineering and Health Sciences at McMaster (2016), a Bachelor of Applied Science in Biomedical Engineering at UBC (2018) and a new bachelor's program at Western (2018). Some of these programs emerged from institutions with long histories in the field—for instance, UBC has offered a Master of Engineering in Clinical Engineering since 1970.

Two themes explored here are: 1) the influence of Asian (particularly Chinese) institutions and 2) the importance of professional training during the degrees. A thread that runs through both sections is the high degree of specialization and customization that is available within these programs—Biomedical Engineering is a vast field, and the variation in curriculum and specialization options reflects this.

BIOMEDICAL ENGINEERING IN ASIA

One of the intriguing aspects of the Biomedical Engineering field is the way it demonstrates a shift in the epicentre of global higher education. While annual changes in global university rankings should be analyzed with some caution, the recent program results in the Shanghai Academic Ranking of World Universities demonstrates that developments in field are becoming increasingly driven by Asian (and particularly Chinese) universities:

Table 1: Top Ten Biomedical Engineering Programs by Country, 2017-19

COUNTRY	2017	2018	2019
United States	9	7	3
China	1	2	5
Singapore	0	1	1
Korea	0	0	1

Along with the five institutions in the overall top ten, the Chinese C9 league makes a strong showing in the Shanghai rankings— 7 of the 9 institutions are in the top 50 of the Shanghai rankings, including Shanghai Jiao Tong (2), Fudan (3) and Peking (9). Both Shanghai Jiao Tong and Peking provide their graduate bioengineering degree specializations online:

Table 2: Graduate Specialisations at SJTU and Peking University

Shanghai Jiao Tong
• Biomedical Instrumentation • Neuroscience and Engineering • Medical Imaging and Informatics • Nano-Biomaterials • Systems Biology and Medicine • Biological Sciences and Diseases
Peking University
• Biomechanics • Biomedical Information and Apparatus Technology • Biomedical Materials • Biological Engineering

While research is a major factor behind the rise of Asian (and particularly Chinese) universities, there have also been pedagogical developments. In particular, Shanghai Jiao Tong's School of Life Science and Biotechnology has several dual degrees and cooperative education programs with international institutions, including joint graduate thesis supervision of students with Drexel University, a combined joint undergraduate/graduate degree in bioengineering with the University of Illinois at Urbana Champaign, and a dual graduate degree with the KTH Royal Institute of Technology (Sweden). The latter degree has students take two semesters at KTH.

Along with a range courses aligning with the specializations above, students take Chinese language courses (though the courses are taught in English). Likewise, the National University of Singapore (NUS) combines a wide range of research topics with an impressive degree of flexibility. NUS and Shanghai

Jiao Tong also jointly offer a PhD program (with a relatively rigourous English language requirement) with a wide range of projects conducted by NUS and SJTU professors. The master's degree is primarily course (or module) based, though all of the courses generally correspond to one of NUS's research areas (Biomaterials/ Regenerative Science, Biomedical Imaging, Micro/Nanotechnology, Biomechanics, and Biomedical Robotics).

The NUS program also has a fine example of Singapore's general commitment to adult learning; they offer a graduate certificate in medical devices regulatory affairs designed to provide professionals in the field with more knowledge about the devices developed by bioengineers and about the global regulatory frameworks that govern them. The full certificate takes a year to complete part time and requires the completion of four distinct modules. The Skills Future program hosted by the Singaporean government can subsidize between 70-95 percent of the tuition for the module, depending on factors such as age and training for people working at SMEs.

PROFESSIONAL TRAINING AND STREAMS

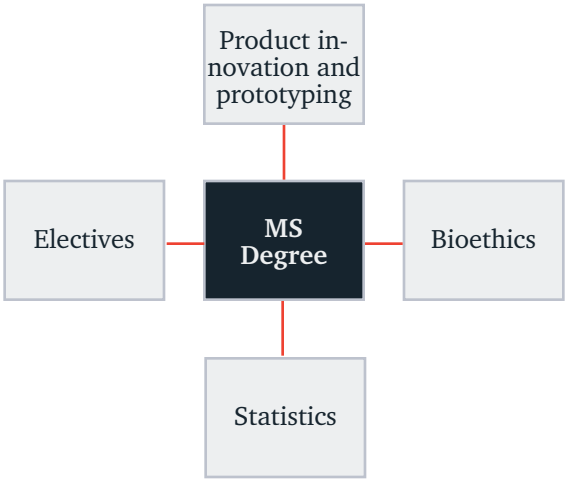
Bioengineering programs are exemplars of the developing trend in creating professionally orientated master's degrees that lead people directly into industry positions. The University of Toronto recently launched a one-year professionally orientated graduate degree with an internship (the MEng from their Institute of Biomaterials and Biomedical Engineering). While the University of Toronto is not the only Canadian university with a professional track (UBC's Master of Engineering has a similar focus), they have one of the clearest presentations of the distinction between the two tracks, which we replicate in part on the next page:

Table 3: Academic and Professional Tracks, University of Toronto

Academic Track	• Two years for completion • Four courses (one semester) and a thesis • Develop a distinct research specialization • Intensive training in a laboratory or clinical setting.
Professional Track	• One year for completion • Seven courses (of one semester), no thesis. • Internship (four months) • Training on product design and commercialization

Top U.S. schools also use this professional track approach at the graduate level. For instance, the University of Illinois at Urbana-Champaign offers a one-year professional master's program that has students work in a capstone project intended to develop a product specifically requested for an industry or academic client. Some recently completed projects include an Intracardiac Electrocardiogram Simulator and a wearable light therapy device for pain and nerve industries. It also offers students an academic specialization (Computational Genomics, General Bioengineering, or Bioinstrumentation) that guides both their course selection and their capstone project.

Similarly, the University of Pittsburgh has a Professional MS in Bioengineering (Medical Product Engineering) which has the following course structure:



Along with these courses, students also complete a full-time internship and completing the process of medical product prototyping. They are expected to understand the market analysis and strategic planning for a prototype and to have some understanding of the patent process.

This emphasis on job market links has also shaped several of the new Canadian undergraduate programs. Waterloo, McMaster, and Western's new undergraduate programs are all expected to take five years to complete and have mandatory co-op and/or internship components. For instance, Waterloo's B.Eng in Biomedical Engineering has its students complete two years of work experience during their five-year program. The program designers also expect that many of their students will go into graduate studies, and thus has students take courses across three themes (Biomedical Signals, Biomechanics, and Biomedical Devices). This expectation may also be a result of the student body—an informal poll of Waterloo's graduating students revealed that the entering high school grade average of the class was 96%. Likewise, Western's program has students commit to one or more research focuses in order to direct their upper year studies and prepare them for further education.

SUMMARY

Biomedical engineering serves as an intriguing illustration of three important programming trends:

1. The rising global reputation of Chinese universities, both in terms of research and in terms of partnerships with other institutions;

2. The continuing and strengthening links between university research and commercial product development;

3. The fundamental importance of specializations and pathways to identify programs that are more professionally orientated and ones that are more academic.

HEALTH AND
THE PUBLIC SPHERE

There are several ways to bring health science research from academia into communities and to patients. Developing programs and approaches that break down silos between research and application has been a growing priority. This section examines two examples of this trend: programs in *Public Health* and programs in *Translational Sciences*. The former group seeks to spread knowledge about health and safety to as wide an audience as possible (while being attentive to the distinctions between various communities), and the latter seeks to bring cutting-edge technology into use more rapidly.

PUBLIC HEALTH PROGRAMS

Public health programs can cover a wide range of specializations, including community health, environmental health, epidemiology, and public health policy. Programs emphasize learning about ways to facilitate health education, developing programs and policies that promote healthier communities, understanding necessary quality assurance processes to test and monitor policies to ensure they are efficacious, and to promote changes that protect vulnerable community members.

In recent years there has been a considerable expansion in the number of Canadian public health programs, particularly at the master's level—the University of Ottawa approved a new master's in public health that is particularly geared towards its institutional strengths in public policy and bilingual education. Other recently-created programs include Western (2013), McMaster (2014), Brock (2015), and the University of Victoria (Masters, 2010).

Stretching back a bit further, SFU established a master's in population and public health in 2007, the same year that the University of Saskatchewan opened a School of Public Health.

The field has also hosted some intriguing academic collaborations—most notably, the creation of Regional Training Centres to promote "applied health and nursing service research" in the West, Ontario, Quebec, and Atlantic Canada in 2002. While the training centres are gone, the four Atlantic institutions (Memorial, University of New Brunswick, University of Prince Edward Island, and Saint Mary's [previously Dalhousie]) continue to jointly offer a Master's in Applied Health Services through the Atlantic Regional Training Centre.

A common element in many of the new programs is that effective public health programming requires attention to global trends. For instance, Western's Master of Public Health program has a vision statement that says: "We envision a world where health is within reach for each individual, supported by healthy

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and sustainable communities, and equitably achieved across human populations through the transformation of policies and health services delivery." New York University recently established a School of Global Public Health (in 2015), putting forward a vision "to significantly improve the health of populations by pioneering solutions that advance health equity around the world, today and tomorrow." SFU notes that their MPH students have completed practicums in 55 different countries.

Given the wide subject range of this field, many different specializations and concentrations can be offered. For instance, the Karolinksa Instiutet in Sweden, one of the world's top ranked public health institutes, offers three distinct specialized programs within its Department of Global Public Health: Public Health Sciences, Global Health, and Public Health Disasters (the last is in collaboration with the Universidad de Oviedo and the Université catholique de Louvain). The distinction between Public Health Sciences and Global Health is instructive; the former program has students take more courses in epidemiology and biostatistics, while Global Health is more orientated towards policy research and understanding different global contexts.

Generally, there are a few main subject areas that emerge between the various programs scanned as part of this study:

Methodology	• (Bio)statistics and epidemiology • Qualitative studies • Community-based research
Public Engagement	• Working with different social groups • Encouraging action and responses • Ethics
Policy	• Assessing health policies • Translating knowledge to policy • Understanding government roles
Science	• Understanding physical environmental factors • Nutritional science • Social sciences • Toxicology

The figure above is a suggestive, not comprehensive, overview and not all programs include these elements. However, it provides a broad indication of some key areas of research in this field. Another way to consider the field is through the Council for Education on Public Health (CEPH), which identifies the "three Core Functions of Public Health—Assurance, Assessment, Policy Development."

Public Health Accreditation

There are four schools in Canada that currently hold accreditation through the U.S. based Council for Education on Public Health (CEPH): the University of Alberta (2012), Simon Fraser (2015), Western (2016), and the Université de Montréal (2017). UdeM is the only French language school accredited by CEPH. The process requires that schools undergoing accreditation publicly release a comprehensive set of indicators and commitments, meaning that these public health schools are more transparent than most Canadian university programs.

There are many components to the accreditation process, but some areas that stand out include:

- Demonstrated commitment to a mission statement associated goals along with demonstrable measures for assessing whether the goals are being achieved;
- Courses that provide education for five Core Knowledge areas: Biostatistics, Epidemiology, Environmental Health Sciences, Social and Behavioural Sciences, Health Services Administration;
- A commitment to monitoring student satisfaction and including student perspectives in program governance and design;
- Ongoing monitoring of student placement experiences and employee perception of school graduates, along with tracking graduate employment outcomes;
- Monitoring of faculty engagement with community projects and public research.

The accredited programs also have clear statements of the sorts of competencies that they expect students to learn, both as a program level and for any specializations. For instance, Western's program has twenty-two core competencies (such as "Select methods to evaluate public health programs") that they view as generally applicable to public health and five concentration competencies that speak directly to their program strengths (such as "Apply public health economics to advance evidence-based decision making in public health policy and practice.")

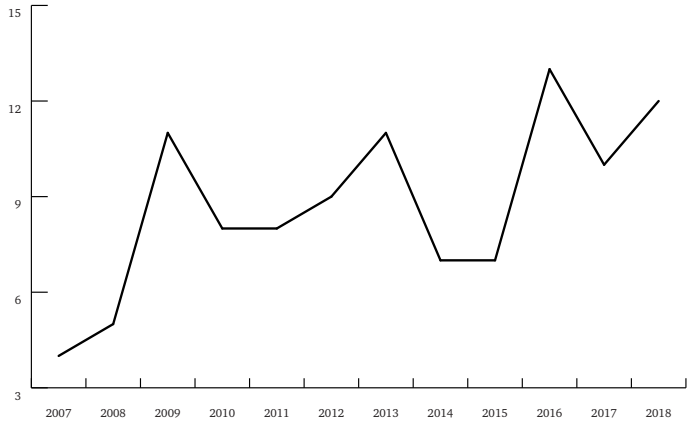
L'Université de Montréal's École de santé publique, which launched in 2013, stands out as a particularly innovate program in terms of allowing stacking and laddering between different degree levels. Students can move between 15 credit microprogramme de 2e cycle en santé publique, a Diplôme d'études supérieures spécialisées worth 30 credits, and the full maîtrise en santé publique. There are several specializations and study options within each of these pathways that can link with each other. According to the CEPH report in 2017, a total of 286 students enrolled in UdeM's non-degree programs in 2015.

The UdeM's école was accredited by the CEPH in 2017 and was the first (and thus far only) francophone program to be so. Interestingly, the initial accreditation decision was probationary until the institution adhered to the CEPH requirements concerning defining desired outcomes and tracking graduate employment and alumni and employer perceptions of graduate ability—all areas in which Canadian institutions can often lag behind. By submitting to CEPH accreditation, UdeM allowed its program to receive a considerable amount of external and publicly available scrutiny, identifying areas of program strengths (strong job placement rates, a robust internship component, strong faculty research profile) and areas where improvements are needed (e.g. use of data on performance to inform planning and decision making). The program also recruits a considerable number of students from Africa (29% of its 2018 student body).

An interesting feature of the public health schools at the University of Alberta and Simon Fraser University is how they are both non-departmentalized. They have different degrees and specializations within the school. However, main funding and governance decisions are made by the Dean in consultation with faculty through town halls and other means. Both programs believe that their non-departmentalized approach allows for more interdisciplinary connections. For instance, the 2017 University of Alberta self study indicates that the faculty voting to make the School non-departmentalized "recognizes that, by definition, public health is multidisciplinary, requiring collaboration and cooperation in order to achieve our mission of advancing the public's health." In practice, this means that many faculty provide research and teach courses for more than one program and that there is a shared core of courses across several different programs.

In North America, there has been a steady movement in public health towards accreditation. Seeking external accreditation means that there is increased scrutiny, but it also signifies an intent to adhering to publicly available goals, measures, and outcomes. The CEPH accreditation numbers demonstrate a reasonably steady growth in the number of institutions (all in the U.S., with the exception of the four Canadian institutions above) that are interested in undergoing this external quality assurance review. The figure on the next page provides the number of newly accredited institutions since 2007; it includes a dotted trend line that demonstrates a gradual but steady increase.

Figure 1: Newly CEPH-accredited Institutions, 2007-18



Making a direct link between accreditation and better program outcomes or enhanced employability can be difficult. However, the CEPH accreditation report for SFU from 2015 provides an interesting perspective, noting that unlike in the United States, few relevant positions in Canada explicitly call for a Master of Public Health. One benefit of accreditation—or at least making the competencies and skills that a student acquires from a program publicly available—is that it helps to signify to employers what it is that a student from a program can do. While every institution needs to decide whether the price for going through an accreditation process is worthwhile, there should be serious thought about how each program communicates what training it provides its students to prospective employers. Transparency is important in this field.

TRANSLATIONAL SCIENCE PROGRAMS

Public health seeks to develop programs that can be effectively implemented with different groups, connecting knowledge around epidemiology and other fields to practical steps to promote public safety. Translational science seeks to accelerate the implementation of new cutting-edge technologies in a safe and responsible way. For instance, the University of Toronto's program's mission statement wants their graduates to "Become a professional health translator by learning to apply scientific knowledge to improve medicine, health, and care."

There are three fairly new programs in Canada in this field: the University of Toronto's Masters of Health Science in Translational Research and the University of Alberta's Translational Health Program. Queen's University also launched a MSc and PhD in Translational Medicine in 2018. These programs speak to a major public issue—the need to link laboratory and research results to patients and people. Therefore, students in these programs learn about regulatory regimes, understand how to present complex research to a diverse range of audiences, and consider the ethical implications of trials and medical research.

Translational programs take many different orientations. Some, like that of the University of Toronto, are more industry orientated and encourage students to identify needs and develop a solution through prototyping and iterative development. The University of Alberta's program places a greater focus on biological and medical case studies, and generally admits people who are in a PhD program or who already have a PhD or MD. The program at Queen's focuses specifically on biomedical developments and clinical observations.

Translational science programs are still relatively niche, but their gradual development speaks to a general trend concerning the development of programs that examine the intersection between clinical and scientific research, user of that research (such as hospitals and health authorities) and the wider public. The importance of overcoming "silos" that emerge between different users of health research is a long-running theme amongst health care researchers and practitioners, so these programs are valuable to monitor to see what sorts of solutions they offer in addressing the silo problem.

SUMMARY

As recent world events have demonstrated, attentiveness to the relationship between health sciences and the public remains a paramount issue. These programs speak to several trends in this area, namely:

1. The potential of institutional collaboration in program development, particularly amongst smaller institutions;

2. The global orientation of the field, both in terms of developing fair and impactful solutions for a wide range of people and in terms of understanding the global implications of health;

3. The importance of drawing on observations and findings from other disciplines, such as the social sciences, and how they apply to health care;

4. The utility of accreditation (or, at least, a strong mission statement and program outcomes) to guide program development and track graduate outcomes;

5. The need to develop programs that link academia to other sectors.

HEALTH INFORMATICS

Health Informatics is a relatively new field in Canada—the first program launched at the University of Victoria in 1981, and according to Canada's Health Informatics Association, the field was not firmly established at Canadian universities until the mid to late 2000s.

The field has several interesting features that are of interest to a wide array of curriculum designers and program leaders, including:

1. Extensive interaction between fields;
2. External bodies that define core competencies and ideal learning outcomes;
3. Multiple program types, including undergraduate, professional/part time graduate, and doctoral.

The growth of health informatics and bioinformatics in Canada has been quite pronounced. Bioinforamtics.ca, which is hosted by the Ontario Institute for Cancer Research, indicates that there are nineteen institutions that support PhDs in the area, twenty four with master's programs (or, at least specializations within another discipline that support some education in the area), sixteen bachelor's programs, and five certificate programs. Nearly all of them were formed in the last twenty years.

The American Medical Informatics Association (AMIA) released a paper in 2012 that provided the following definition of the field: "Health Informatics is the interdisciplinary field that studies and pursues the effective uses of biomedical data, information, and knowledge for scientific inquiry, problem solving and decision making, motivated by efforts to improve human health." Along with this definition, the AMIA identifies three overlapping domains of knowledge: Health, Information Science, and Social and Behavioural Science.

In 2013, roughly three-quarters of all Canadian health informatics programs, from certificate to graduate degrees, were in southwestern Ontario (COACH, 2013). The concentration of programs in Ontario persists, though since this time new undergraduate programs in bioinformatics have launched at the University of Winnipeg, the University of Saskatchewan and the University of Calgary. The University of Winnipeg program was developed in consultation with Manitoba e-Health, which speaks to the vocational orientation of the field. Langara College is also launching a BSc in Bioinformatics in Fall 2020, which is building off of their existing diploma and associate degree in the field.

Generally, program compositions in this area are designed in such a way to draw on the expertise of several different fields, including biology, computer science, engineering, math, and various social sciences (such as political science). The wide range

of expertise required for the discipline has also led some large institutions to jointly offer a program in the area, such as the Graduate Studies in Bioinformatics hosted by SFU and UBC and the joint graduate programs hosted by Carleton and the University of Ottawa's program. For the Ottawa-based program, there are five participating units drawing from biology, computer science, mathematics and statistics, cellular and molecular medicine, and biochemistry. This also leads to a wide range of students being admitted to health informatics programs—for instance, Dalhousie's program is in the Faculty of Computer Science, but admits students from medicine, pharmacy, nursing, dentistry, and management and emphasizes that students do not need a background in IT to succeed.

Most programs in Canada are in Health Informatics and Bioinformatics/Biomedical Informatics. These are related but distinct fields; biomedical informatics relates to health informatics in that both are concerned with using information sciences and large data sets and draw out useful findings for biological research, including public health research. According to the definition at SFU, bioinformatics "forms the intersection between molecular biology (and related biological disciplines) and computing science."

The diversity of programs and departments involved leads to some interesting program design decisions, particularly at the graduate level, since the programs cannot assume that their incoming students have a consistent body of knowledge. Many programs examined have a general course that introduces students to the informatics field that familiarize students with the challenges and problems that the field covers, some common approaches for contending with these challenges, and generally providing a course concerning the interaction between informatics and biology.

INTERNSHIPS AND PROFESSIONAL DEGREES

While there are several research applications and degrees in this field, such as the recently launched (2014) PhD in Bioinformatics at the University of Guelph, many degrees in this field are orientated towards professional careers. These degrees are distinct from Health Information Management degrees and certificates that are offered by a mix of universities, continuing studies programs, and colleges/polytechnics. Health Information Management tends to be more specifically focused with the crucial task of managing patient files and ensuring the accuracy and safe storage of those files. Health Informatics degrees tend to be at an enterprise/clinical level and develop systems for both administration and for the study of disease and health patterns.

Professionally orientated programs generally offer an internship, work integrated learning, or a capstone project that speaks to an actual clinical need. Canadian programs that include an internship or practicum placement include George Brown, Dalhousie, Toronto, and Waterloo. All of the programs have their students take at least one semester for a work placement opportunity. Students work for a range of government organizations, health networks, clinics, and hospitals. Generally, students who already have some relevant work experience are expected to either find another organization or to work in a different department to expand their experiences.

Along with the internship, key attributes of these degrees include:

- Two-year length, with no mandatory thesis;
- Courses in statistics, health information systems, systems thinking, and security/privacy issues;
- A course that provides a general overview of research and applications in IT and statistics, since people are entering from a wide range of backgrounds;
- Nine to ten core courses, with relatively few elective choices.

Two years ago, Vanderbilt University conducted an extensive review of its informatics internships. It suggested that internships in this field have three main effects: i) providing windows into the field (that is, introducing people to the field and to common vocabulary and job roles), ii) providing mirrors (that is, encouraging students to find people with their backgrounds in the field), and iii) opening doors (that is, providing a path to enter the field, gaining contacts to get entry). An analysis of 10 years of their internships, offered to advanced high school students, undergraduates, and graduates led them to conclude that "internship programs should become a core element of the biomedical informatics educational ecosystem." (Unertl et al, 2018). Effectively, the takeaway seems to be that any program in this field without an internship or work-integrated learning component should strongly consider developing one.

LEARNING OUTCOMES

In 2017, the U.S.-based AMIA identified outcomes associated with each of their major knowledge domains (centred around Health, Information Science and Technology, and Social and Behavioural Science). They also expect people to have skills and abilities associated in areas where these domains overlap. These competencies were developed by an Accreditation Committee comprised primarily of faculty members from various U.S. universities, along with some participation from industry members. The AMIA also has an

"Academic Forum" that promotes sharing ideas about how to build health informatics programs and other issues, such as faculty development and retention. The Forum currently has fifty-four institutional members (all from the United States).

Each of the learning domains has an associated definition of knowledge and skill that a graduate student should have. For instance, in the Health Information Science and Technology domain's skill, it is expected that a student should be able to "design a solution to a biomedical or health information problem by applying computational and systems thinking, information science, and technology." Generally, the associated skills and knowledges are fairly broad (allowing for a wide range of individual programs to make decisions that fit their faculty strengths).

Since there is a fair amount of definitional slippage between the different "informatics" terms, this is a field where providing particular learning outcomes and identifying competencies is vital. Such statements can be helpful for allowing students to understand how the diverse range of disciplines and programs involved might lead to a coherent program and specific knowledge. For instance, the University of Chicago's program highlights four key mastery points:

- Informatics methodology, applying tools and techniques to both research and applied problems in biomedical settings;
- Effective communication with diverse professional audiences regarding informatics issues and solutions;
- Management of biomedical informatics projects;
- Understanding of the ethical, privacy, and data security issues in the field.

The University of Pennsylvania's graduate program has several outcomes that speak to the multi-disciplinary nature of the field, including:

- Identify and draw on the social, behavioral, legal, psychological, management, cognitive, and economic theories, methods, and models applicable to health informatics to design, implement, and evaluate health informatics solutions;
- Design a solution to a biomedical or health information problem by applying computational and systems thinking, information science, and technology.

In Canada, George Brown's Postgraduate Certificate in Health Informatics also provides prospective students with an overview of their outcomes, indicating that students will be able to "formulate change strategies to implement appropriate health information system technologies within the health-care setting." Many college programs in this space tend to be Health Information Management credentials, so George Brown's program stands out in this space. But generally, while Canadian descriptions tend to provide course outlines and highlight key career outcomes, they tend not to prominently demonstrate their learning outcomes. Given that this is still a developing field, more public discussion of those outcomes may help drive more public awareness of what graduates in these areas offer to a range of health industry employers.

SUMMARY

Health informatics is an important field for program designers to monitor generally, because developments there reflect several key trends that are germane to a wide range of disciplines, including:

- The importance of developing learning outcomes that align with external bodies;
- How to structure programs that admit students from a wide range of disciplines;
- The use of clear required competencies to provide coherence to a field and what people need to succeed in the area;
- The value of shared learning competencies to drive public understanding of the field and how it contributes to improved health outcomes;
- The importance of using an internship to increase working knowledge of this complex field prior to people gaining positions.

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IN CONCLUSION

Monitoring Trends in Academic Programs

This second Monitoring Trends in Higher Education has examined program-level developments in a variety of health-related sectors. While some of the observations pertain mainly to a specific discipline, there are several trends that are generally consistent across the programs here:

- **Global orientation**: Many fields speak of the global ramifications and scopes of their studies; these are fields that largely default towards a global scope. However, this has ramifications in terms of institutional competition for top students, particularly as Asian universities become more influential in these fields.

- **Learning pathways**: All three of the fields considered here generally develop programs that give students concentrations and pathways, especially at the graduate level. The power of some of these pathways is how they can lead directly to employment, particularly through capstone projects that work directly on issues identified by external organizations or on projects desired by industry clients. There are also several programs (particularly within Biomedical Engineering) with professional and academic tracks that might be usefully considered by other disciplines.

- **External quality control**: This is not a trend that includes all programs assessed here, but some of the programs examined demonstrates some positive outcomes from external quality control, such as more transparency around program outcomes and greater clarity around learning objectives.

- **Mission-driven education**: Many of the programs examined here had clear mission statement and program outcomes, often to a level beyond that typically seen in Canada. This helps to drive recruitment messages and provide prospective students (and employers researching a program) with a clear idea of what the program is trying to achieve.

- **Interdisciplinary education**: . The health sciences are a fascinating area to study for people interested in learning about the construction of interdisciplinary programs. Essentially all the programs examined as part of this review draw from multiple departments to create programs that can admit students from a wide range of backgrounds, from computer science to sociology.

This document is just an example of some of the work that Higher Education Strategy Associates provides for program analysis and review.

At HESA, we keep a close eye on academic trends to understand what programs are attracting students and the sort of studies that attract and excite students.

Our company has produced reviews for disciplines ranging from drama to sociology.

But that is not all that we can do for our customisable Program Development Reports. Other report features include:

- *Analysis of student figures to develop estimates for potential enrollments*
- *Student surveys to better understand current needs and interests*
- *Detailed reviews of relevant economic trends*
- *Thorough investigation of in-demand skills that students will need to get a job in their field of study.*

Any program review begins with a discussion where we work to understand your needs and develop a work plan that will help meet them. Sample tables of content are also available upon request.

If you are interested in customised and in-depth reviews for new or existing programs, e-mail us at info@higheredstrategy.com.

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