



Full-Length Paper

**Library or iSchool Involvement in
Health-Related Informatics Education**

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Abstract

Objective: An underexplored area in Library and Information Science (LIS) is the development of educational offerings and partnerships in Health-Related Informatics (HRI) (e.g., bioinformatics, clinical informatics, health informatics). The purpose of this study is to identify which disciplines are collaborating in HRI education and how partnerships developed.

Methods: This study was conducted in two parts: a website review and survey. Seventy-seven North American ALA-accredited and iSchool member websites were searched between November 2019-March 2020 for HRI-related educational offerings and which academic units were involved. Two hundred sixteen individuals involved in LIS and/or HRI education were contacted for a 40-question survey that included: their roles and responsibilities regarding HRI education; the alignment of this education with strategic plans or competencies; and how HRI partnerships developed. The survey also asked those who were not currently partnering in HRI education which factors influenced their circumstances.

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Data Availability: The data and related materials are available in INDIGO, the institutional repository for the University of Illinois Chicago. (Website data: 10.25417/uic.19163753. Survey instrument: 10.25417/uic.19161983. Survey data: 10.25417/uic.19164125.)

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Abstract Continued

Results: 352 HRI educational offerings existed within ALA-accredited or iSchool programs. A total of 38 (17.5%) responded to the survey. For almost two-thirds of these, there was no indication of partnership in that education (213/352, 60.5%). LIS or iSchool involvement in HRI is just under one-third of all offerings (111/352, 31%). “Health or healthcare” informatics (35) or “biomedical or bioinformatics” were the most common types of HRI offered from the website review and survey.

Conclusions: Opportunities exist for LIS programs to form HRI educational partnerships that will provide richer educational offerings for LIS students and health sciences librarians.

Introduction

Librarians have partnered with health-related informatics (HRI) programs in clinical and health care educational contexts to provide training on specialized information resources, reinforcing the need to train Library and Information Science (LIS) professionals on targeted HRI curriculum. Librarians can develop educational offerings and consistent training for healthcare professionals through collaborating in curriculum development and education on bioinformatics tools and resources used in clinical practice. These offerings can be tailored to address the HRI needs within disciplines such as dentistry, nursing, and public health.

Institutions offering HRI developed these offerings in response to their organizational needs and/or their health care professionals or students' interests. Because of HRI's interdisciplinary nature, HRI educational offerings, such as degrees or certificates, may involve collegial or departmental collaboration or be offered by professional HRI organizations. The distinctions between offerings vary drastically between institutions and HRI subdisciplines because of the grey area between interdisciplinary boundaries. The consequence is that there is no standard HRI curriculum offered across institutions, and partnerships with LIS to facilitate such training develops from individual circumstances that share common needs and values but manifest differently.

In 2019, the authors looked at health informatics education opportunities within American Library Association (ALA)-accredited programs by examining their websites to determine their health informatics offerings. Almost two-thirds of institutions with ALA-accredited programs were involved in health informatics education and this was seen more often when the ALA-accredited program offered health science librarianship education. However, that study only looked at health informatics education (Raszewski 2019). It also illuminated more questions regarding who participates in providing health informatics educational opportunities. LIS and HRI are interdisciplinary fields that share a common history and would be expected to partner in education and research.

As there is no literature on how partnerships in HRI education are formed, the purpose of this study is to identify how they have developed, what subtypes of biomedical informatics are offered, what factors support or undermine collaboration, and which disciplines participate in these partnerships, specifically at institutions with ALA-accredited LIS programs and/or iSchools. To do this, we identified participants from institutions that have an ALA-accredited and/or iSchool program and invited them to take a survey that asks descriptive questions on who is partnering with whom, what that partnership entails, how the partnership developed, what factors support it, and whether partnering in HRI informatics is linked to professional competencies or college or department mission and values. We also asked why institutions offering HRI education may not be partnering at this time with LIS and which factors influence that decision.

Literature Review

Librarians and informaticians have been characterized in the literature as “boundary spanners who can bridge the technical and the human information needs inherent in providing health care” (Perry, Roderer, and Assar 2005). Biomedical informatics and LIS draw from similar domains of knowledge such as “philosophy, psychology, computer science, and communications” crossing established disciplinary lines (Dalrymple and Roderer 2010). In a survey of 1011 health informatics practitioners affiliated with the American Medical Informatics Association (AMIA), many of the respondents had background knowledge from training in clinical, public health, computer science and “health informatics” (Gadd et al. 2020). LIS and HRI also share a common foundation in the organization, storage, retrieval, application of data, information, and knowledge; even though these fields emerged from different “sociocultural and historical backgrounds” (Dalrymple and Roderer 2007). The ability to compile data from otherwise disparate data sources and produce visual composites using that information is one of the benefits of health informatics education (Modi et al. 2019). Still, “there are limited published examples of health informatics educational activities that librarians can use as models for librarian roles in informatics education” when searching for literature that addresses the role of librarians in informatics education, and even less regarding partnership within informatics offerings (Lauseng et al. 2021).

Role for librarians in informatics

Librarians’ roles in academic and medical education settings have become an increased area of focus for professional discussion. For example, “Academic instruction” and “patient education” were the second and third most popular categories in Medical Library Association (MLA) conference presentations between 2001-2019, (Myers 2020). Information professionals are increasingly called to aid and train other medical informatics and clinical professionals on navigation and use of connected health resources (Cleveland 1995). As of 2018, there are 3,356 active National Institutes of Health funded projects that explicitly mention “bioinformatics,” some of which are supported by their institutional libraries (Wheeler and Oxley 2018). In addition, the National Library of Medicine (NLM) has been actively funding and providing biomedical informatics training for over 20 years in partnership with librarians (Dalrymple and Roderer 2007). This continues in the NLM Strategic Plan for 2017-2027 which intends “to unleash the potential of data and information to accelerate and transform discovery and improve health and health care.” (National Library of Medicine (U.S.) Board of Regents 2017). Goal 1 to “provide the tools for data-driven research” involves the discovery and use of information (data) as well as providing access and infrastructure, which can be covered in LIS training with health sciences professionals. Goal 3 to “Building a workforce for data-driven research and health” intends to train information professionals for clinical environments to ensure data science proficiency, encourage a diverse workforce, and promote data literacy in medical training (National Library of Medicine (U.S.) Board of Regents 2017).

Although there are many individual opportunities for pursuing degrees or certifications in HRI, partnership with LIS is not seen within these educational offerings as frequently as within integrated courses. For example, McClatchy discusses the training of researchers to include bioinformatics curriculum and data driven computational tools tailored to the researcher's specific needs and skill levels, but any mention of collaborating with the library to facilitate this training is beyond the scope of the article (McClatchy et al. 2020). However, literature has shown that librarians fill educational gaps in health science curriculum, in addition to training opportunities for prospective bioinformatics or health science librarians (Lynch 1999; Giuse et al. 1997; Cahn et al. 2007; Homan and McGowan 2002; Liaw and Gray 2010; Wheeler and Oxley 2018). Moore argues that "librarians are uniquely situated to develop bioinformatics collaboration networks" through supporting free electronic resources, demonstrating institutional knowledge, and creatively choosing partners to help develop these collaborations (Moore, Vaughan, and Hayes 2004). Research by Ullah and Ameen recognized the need to improve information literacy training for medical students through mandatory, "for-credit" instruction programs led by librarians, who would design curriculum in collaboration with medical faculty (Ullah and Ameen, 2019).

Case studies and educational program overviews identified specific programs or gave an overview of recommended curriculum for LIS education and HRI education (Detlefsen and Galvin 1986; Cleveland, Holmes, and Philbrick 2012; Detlefsen 1993; Giuse et al. 1996; King and Lapidus 2015; Cobus 2008; Geyer and Irish 2008; Homan and McGowan 2002). Other recent successful programs were established at the University of Washington, Houston Academy of Medicine-Texas Medical Center, University of Florida, University of Pittsburgh, Purdue University, University of North Carolina at Chapel Hill, and Vanderbilt University, each with their own needs and requirements according to their organizations (Wheeler 2018). These studies reflect the ongoing relationships between university medical health systems and health sciences librarians. Still, these programs are not widely available and more can be done to integrate LIS in bioinformatics training. The librarians' role has grown to become partners who provide library instruction on bioinformatics tools, research support, and curriculum development (Brandenburg and Garcia-Milian 2017). However, specific skills and opportunities for librarians vary depending on the institution type and the relationship between the clinical or educational setting and the library as an entity.

Existing partnerships

The educational opportunities within health informatics offerings provide examples that demonstrate librarians' understanding of medicine, medical education, and the clinical enterprise so that instruction modules are relevant and meet a clinical audience's needs (Faraino 1998; Lyon, Tennant, and Messner 2006). There are partnership examples with the library and discipline specific HRI such as dental, nursing, social work, public or consumer health informatics, but most fall into general informatics, health informatics, or biomedical informatics. There are also examples of partnership on HRI education in academic settings (Allee et al. 2014;

Brahmi et al. 1999; Cleveland, Holmes, and Philbrick 2012; Van Moorsel 2005; Cleveland 1995). These collaborations allow the health sciences community to learn skills that complement their clinical skillsets which are not included in traditional health sciences curricula. Students enter the program with various backgrounds, and this bridges health sciences librarianship and the “technology focus of medical informatics” (Cleveland 1995).

Prior research suggests that library informatics instruction will be most effective when integrated into the curriculum (Eldredge et al. 2013). However, librarians are seldom mentioned as partners that help create or evaluate programs, even if they participate in informatics instruction. Librarians also have different attitudes about interprofessional collaboration in education, though most health sciences librarians are in favor of such activities regardless of their participation in such programs (Hinrichs et al. 2020).

Integrating LIS offerings within health informatics programs may be a challenge due to the lack of capital resources and infrastructure needed to support HRI training (Van Moorsel 2005). Van Moorsel also addresses the competitive aspect of access to bioinformatics curricula, and how “Librarian-educators must demonstrate measurably the efficacy of such instruction.” Another challenge is difficulty in adding more courses to programs with high core course requirements, urging the consideration of alternate avenues such as offering these courses online in a self-directed environment (Olmstadt and Hannigan 2000).

The present study further explores the ways partnerships in HRI education have developed and identifies disciplines that partner with ALA-accredited LIS Programs and/or iSchools. A better understanding of existing partnerships will illuminate next steps in developing collaborative offerings in HRI.

Methods

This study was conducted in two parts. First, HRI programs’ websites at United States institutions with ALA-accredited programs and/or iSchools were examined to determine their HRI educational offerings, if any. Websites are the most common way for most institutions to communicate about course offerings as students are finding details about these programs primarily online (RNL, *E-Expectations* 2021; RNL, *Graduate Student Recruitment* 2021). Institutions with ALA-accredited programs were identified through the ALA public directory (<https://www.ala.org/educationcareers/accreditedprograms/directory/search>) and institutions with iSchool programs were identified through the North American iSchools directory (<https://ischools.org/North-American-Directory>). These website reviews occurred between November 2019 and March 2020. A list of any courses, degrees, or programs were compiled by name and description. The authors searched for “informatics” within course catalogs, program websites, or the institutions’ website, documenting any offering with HRI in the title. Data collected included the informatics discipline, offering type (single course, degree or degree concentrations, certificate, etc.), college(s) or programs(s) offering the education,

what involvement the ALA or iSchool program had, and contact information. Partnership was interpreted broadly and was indicated if there were multiple academic units involved of any kind. Full inclusion and exclusion criteria are listed in Appendix A.

In order to gather nuanced responses about involvement and partnership in HRI education that was not present in the data captured in the website review, the second part of this was an online survey asking program directors, course coordinators, deans, or others about their discipline's involvement in HRI education. A participant list was compiled by reviewing programs' websites for contact information on program directors for these programs. If there was not a program director, a graduate or undergraduate program director or dean was selected.

The survey contained forty questions and took approximately 30 minutes to complete (see Appendix B). Participants were asked about their roles and responsibilities regarding HRI education; the HRI offering types and discipline focus; the alignment of this education with strategic plans or competencies; instructor demographics; details about how partnership in HRI education developed; and anticipated changes in the education offered or the partnership. The survey also asked those who were not currently partnering in HRI education which factors influenced their circumstances.

Eight library faculty who had experience teaching informatics or had survey design experience or both tested the survey; we then edited the survey for bias and clarity based on their feedback. IRB reviewed the survey and determined it to be exempt. The survey was distributed in Summer 2020 for 6 weeks. Two email reminders were sent out: one at 3 weeks, one 1 week before survey close.

Data from websites and the survey are presented as counts, percentages or ratios, and simple statistics. Survey responses from 3 free text answers were analyzed with Dedoose qualitative data analysis software. For these, an initial code list was developed, and one author (RR) did the initial coding. After the first coding cycle, two authors (TG and RR) built upon the initial coding through discussion and then refined the codes. In the second cycle, two authors (TG and RR) coded according to the refined list. They then discussed code application until consensus was reached.

The data and related materials are available in INDIGO, the institutional repository for the University of Illinois Chicago. (Website data: 10.25417/uic.19163753. Survey instrument: 10.25417/uic.19161983. Survey data: 10.25417/uic.19164125.)

Results

After website review, there were 352 education offerings across 61 institutions with an ALA-accredited program, 48 that were iSchool members, and 37

institutions with both designations. Two hundred sixteen individuals were contacted for the survey from those institutions and programs. Responses were excluded if they did not contain any data (2), but partial answers were retained (2). No answers were combined because individuals were from the same institution. There were 38 final responses, calculating to a 17.5% response rate.

Roles and responsibilities

The thirty-eight survey respondents held a variety of titles and roles, as reported in Table 1. Many respondents indicated a faculty position in addition to an administrative role.

Table 1: Title and roles of respondents.

Title/Role	Count
Faculty	16
Director	15
Program / Department Chair	3
Division Chief	2
Dean	2
Program Coordinator	2
Department Head	1

Thirty-two of 38 total respondents indicated that they were involved in HRI education at their institution. Half of those (16/32) identified HRI education as a primary responsibility. Table 2 outlines identified responsibilities. Fourteen respondents had either 3 or 4 responsibilities while twelve responses indicated only one responsibility. The average was 2.4 responsibilities over all responses.

Table 2: Responsibilities of respondents.

Responsibilities	Count
Program administration/Course coordination	22
Instructor	20
Curriculum/Course development	19
Provide resources or tools	10
Other	7

These respondents also indicated their time in that title or role, reported in Table 3.

Table 3: Time in role of respondents.

Time in Role	Count
1-5 years	15
6-10 years	9
11-15 years	4
16-20 years	2
20+ years	2

Partnership

Three hundred fifty-two HRI educational offerings existed within ALA-accredited or iSchool member programs, according to website analysis. For almost two-thirds of these, there was no indication that the ALA program or iSchool educational offering was partnered within the course title, description, or number (213/352, 60.5%). A little over one-third were partnering, and three were unable to be determined.

Looking further, LIS or iSchool involvement in HRI is just under one-third of all offerings. (111/352, 31%). iSchools are significantly more involved than ALA-accredited programs at 85/352 (24%) versus 17/352 (4.8%). Thirteen programs that were both iSchool members and ALA-accredited were involved as well.

For institutions that were involved, LIS programs were evenly split between partnering with other units (52/111) or not (56/111).

For the 2/3 of offerings where there was no participation by the LIS/iSchools, there were 78 that already existed in partnerships between other academic units, and 155 offerings where a single academic unit is providing HRI education (Table 4).

Table 4: Count of LIS/iSchools not involved in HRI education.

Not Involved	Solo	Partnered
Library program	69	23
iSchool program	25	12
Combined program	61	43

When survey respondents were asked "To what extent do you think LIS or iSchools should collaborate with other interested parties in offering health-related informatics?" most selected either "a great deal" (15/35) or "considerably" (10/35), while 8 replied "moderately" and one each replied "slightly" and "not at all." When asked if they were partnering in HRI education, 26 said yes while 10 said they were not. Of those that replied "yes," we asked who initiated the partnership. Ten said the LIS program did, 8 replied other non-LIS departments, 2 institute/centers initiated, and 5 non-academic units did.

Table 5 outlines reasons why respondents invited others or were invited as partners. Respondents could select more than one response.

Table 5: Reasons for engaging in HRI education partnership.

Reasons for Partnership			
Reason invited others (N=10)	Count	Reason accepted invitation (N=15)	Count
Aligned mission/value	9	Aligned mission/value	11
Developed content	8	Developed content	9
Provided personnel	4	Provided personnel	3
Provided technical infrastructure	1	Provided technical infrastructure	2
Other	1	Provided funding	1
Provided funding	0	Other	3

For the three responses that accepted the invitation to partner but checked "other reason" and elaborated, one said the partnership was in place prior to when they arrived and a second mentioned doing research together. The third said that they had the "intent of doing research (including interprofessional education) and understanding more about this growing field so that I can integrate it into the med lib courses and IR, reference, grant-writing, and more".

Similarly, when survey respondents were asked if they anticipated any changes to the partnership, most responded no (20). Of the six that responded "yes" and elaborated, three expected to adding more partners and undergraduate courses. The other three had a variety of answers such as "Less domain specific learning available from iSchool-will reduce scope of partnership" and "Ongoing review and expansion of curriculum and access" and "The Master's program was changed to an independent program."

Education offering types and disciplines represented

According to website review, most HRI offerings were stand-alone courses not associated with a specific degree (44.9%, 158/352) followed by master's degrees

(21.3%, 75/352), doctorates (11.4%, 40/352), certificates (10.8%, 38/352), and bachelor's degrees (9.9%, 35/352). Few institutions offered nothing (1.7%, 6 institutions) (Figure 1).

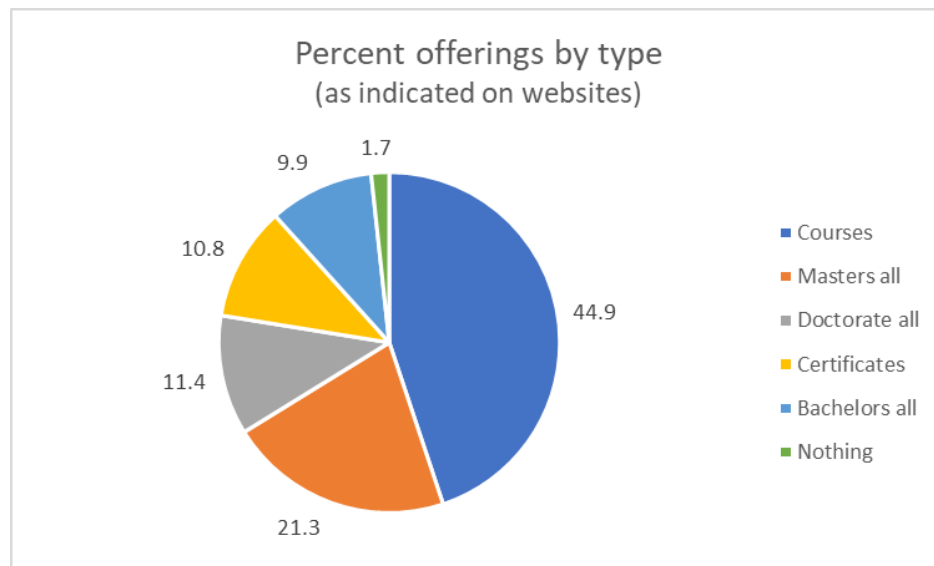


Figure 1: Education credential types by type as identified on institutional websites.

Most survey respondents were involved with graduate or professional degrees like PhDs or MDs (25) followed by credit bearing courses (24) and certificates or similar offerings (13). Seven were involved in non-credit bearing workshops and 5 were involved with undergraduate degrees. Regarding graduate or professional degrees, nine respondents had been involved with those offerings for 5 years or less, and five others having been involved for 6 to 10 years. The remaining seven respondents spanned from 10 to 20 years. For credit courses, ten had been involved for less than 5 years as well. The remaining respondents stretched approximately equally between 6 to 20 years.

As health informatics is a subdiscipline of biomedical informatics which includes other informatics types such as bioinformatics, clinical informatics, and public health informatics (Kulikowski et al. 2012), the survey asked about the discipline focus of the education offered. Unsurprisingly, most common was general "health or healthcare" informatics (35) or "biomedical or bioinformatics" (16), like data gathered from program websites discussed below. Interestingly, nursing informatics had 9 survey responses while other disciplines named through free text answers were medical or clinical informatics, public health, or consumer health informatics.

The two most common disciplines present through websites were bioinformatics (35.8 %) and health informatics (30.4%) followed by nursing (9.4%), healthcare (6.0%) and biomedical (5.4%). The remainder were discipline specific and less than 5%, individually. There were 6 offerings that were a combination of types, such as biomedical and health or clinical and public health (Figure 2).

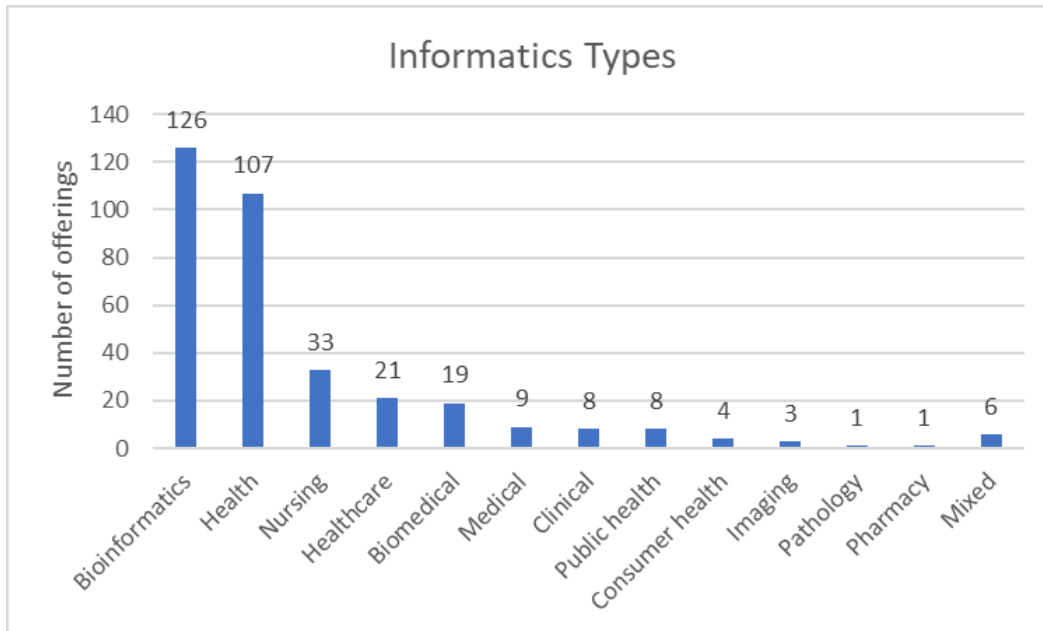


Figure 2: Informatics disciplines represented in education offerings.

Unsurprisingly most health science disciplines were represented. Non-health partners documented were largely from the sciences, mostly engineering and computer science, but also informatics (not health), information science, social science, veterinary medicine, and technology. Non-science disciplines participating were arts and science college, communication, business, education, and general or professional studies. The full list of disciplines represented is in Appendix C.

Instruction

When asked about the number of instructors teaching HRI, 21 respondents have between 1-4 instructors followed by 13 who have 5-9, and 11 each have either 10-14 or more than 15. Nine were unsure about the instructor number. Of the 21 with 1-4 instructors, ten teach stand-alone courses.

Mostly LIS/iSchools faculty and health professions faculty are teaching HRI (16) followed by informaticians (13), STEM faculty (12), business faculty (3), humanities/social sciences (2) responses, and 1 other. Most educational offerings were delivered through online education (26) followed by blended (25) and face to face (15). Several indicated the format was due to COVID19 circumstances.

Twenty respondents answered that their HRI education aligned with published competencies. Seven answered no and 9 said they were unsure. The top two competencies were American Medical Informatics Association's competencies (10) and the American Library Association Framework (8). The Association of College and Research Libraries (ACRL) and the Medical Library Association (MLA) followed with 3 each, and the Digital Health Canada (COACH) and International Medical

Informatics Association (IMIA) received 2, while Technology Informatics Guiding Education Reform (TIGER) received 1. Five respondents gave free text answers that were mostly health sciences related: the Informatics Nursing Certification by the American Nurses Credentialing Center, Healthcare Information and Management Systems Society (HIMSS), Council on Education for Public Health (CEPH), National Center for Healthcare Leadership for Health Administration, and the Interprofessional Informationist Competency Framework.

Twenty-two respondents did not expect changes to their curriculum. For the 13 that did, changes expected were in the number of students (7) and instructors (6), modifying the delivery of the instruction (7), aligning competencies (5), types of degree offered (3), change in informatics type (1), and other (1). No response indicated that they were reducing or eliminating offerings. When asked to elaborate by free text answer, replies were adding a certificate, adding graduate degree, and generally changing the informatics program for changes regarding degree type. For aligning competencies, respondents wrote "alignment with health science libraries having knowledge repositories, and health informatics students increasing use of resources and services"; "professional level skills for graduate courses"; and "meet market demands and student career goals." Changes in instruction delivery are due to COVID 19 and hybrid formats will likely remain.

Strategic Planning

Twenty-eight survey respondents indicated that HRI education involvement aligned with their departments or colleges' strategic plan (28/37; 75%). When asked to elaborate, six respondents wanted to address research and educational needs mentioned in their university, college, or department's strategic plans. Other alignment reasons included preparing their graduates for future careers or leadership roles and achieving status among peer institutions. For example, one respondent mentioned preparing their "graduates for health system leadership" while another wanted to raise their institution's profile towards becoming "a top 20 institution."

Fourteen responses reflected aspirational and current practices regarding health and collaboration in their strategic plan. One respondent wrote "Bringing this vital aspect of health services to the informatics field, and bringing the philosophies of informatics (connecting people to information using technology, user based information services) to the health services curriculum," while other respondents mentioned "Timely informatics specialties, collaboration with other university disciplines in departments" and "foster transdisciplinary collaboration within and among schools." Two respondents also mentioned grants that they had partnered on. One focused on curriculum development so students can "understand health communication, health problems, and also to be able to work with doctors and nurses" while another focused "on health equity and specifically access to appropriate health information in lower-income areas."

Eleven respondents mentioned their educational offerings or where they were located within their university. For example, one respondent wrote that their “educational offerings span biomedical informatics at multiple levels and reflect my department's strategic plan for university-based academic programs for research-based biomedical informatics and applied clinical informatics,” while another mentioned that “community health is a strategic area since there is a different division that focuses on health informatics but is not an academic unit.”

Related to strategic planning, respondents were asked what the main responsibilities of LIS/iSchools towards HRI education were. Three respondents wanted students to be prepared for future careers, with one respondent using the phrase “in demand.” One wrote providing “a home for Health Informatics education” while another wanted students to “be able to find Health-related information sources, distinguish reliable from unreliable sources, and to be able to educate their users.” One respondent mentioned diversity, equity, and inclusion, writing “It is the responsibility of any educational institution is to produce students that will bring an equity and anti-oppression lens to their chosen field.”

Several responded in a way that promotes LIS philosophy or values. For example,

- “We are the only area that looks at information holistically—this includes health informatics.”
- [students would be provided] “exposure to information science principles from outside biomedicine.”
- “I think there's a lot that can be done in this area. Mostly it seems to be the province of medical schools at the moment, but I'm not sure they bring an informatics perspective.”

Five respondents referenced health sciences librarianship. One respondent commented that HRI was “Very essential for LIS schools that provide health/medical librarianship programs.” Another commented that they see “health informatics as part of a suite of courses for students interested in focusing on medical or health librarianship.” One respondent did have difficulty collaborating with their LIS/iSchools. Although they were open to collaboration, they had “not settled on opportunities that make sense...Our [students] get well-paying jobs upon graduation and it does not make sense for them to pursue LIS education.”

Not Involved

Only six respondents indicated they were not involved in HRI. Reasons selected were no appropriate partners, lack of personnel, time constraints, lack of “buy in” from department or college, and no interest or willingness to participate. Only one chose “does not align with mission, values, current service offerings.” Free text answers included that content used to be offered but they discontinued it due to lack of student interest; that they did not do HRI related informatics education; and that Health Informatics programs prefer to be independent. When asked to

further explain common themes, there were no faculty within the program who were interested or qualified, lack of resources, and lack of demand to reestablish these types of educational offerings. One respondent wrote that their LIS program began examining a potential partnership, but it was decided that the “health informatics program would establish itself independently”. “I am not in [the] health science field but in information science instead, so without collaborating with health science faculty, there is no way to initiate a health-related informatics program in the university.”

Discussion

Current computing and technological advances combined with increased health and disease understanding means the HRI education need will only increase. As seen with the survey respondents, two-thirds of educators were taking on multiple responsibilities to provide this education, such as course coordination, instruction, and program administration. With this workload, it appears that there are ample opportunities for many to be involved in HRI.

When looking at websites, only one-third of LIS/ iSchools are participating in HRI education. This conflicts with our survey data which showed over seventy percent of respondents think that LIS programs or iSchools should be involved to a “considerable” degree or greater. In our previous work, we showed that 65% of institutions offered health informatics education and LIS/iSchools were involved in a little over sixty percent of those. When looking at HRI education that now includes subdisciplines, we see that the involvement is not as robust. LIS/iSchools involvement is just under one-third of all offerings available.

But involvement does not mean partnership. When involved, half the LIS/iSchools are offering HRI on their own. More telling is the two-thirds where the LIS/iSchools are not involved. Within that group, most are also offered through a single academic unit. Respondents that anticipated changes in their educational offerings expected them due to numbers of student or instructors, and with format type. LIS/iSchools can offer to share the educational load of HRI education by partnering with existing offerings and simultaneously incorporate information science perspectives. Leaning on shared values in mission or goals, or formal strategic planning may create the circumstances that allows educational partnerships to flourish and there is abundant opportunity to do so.

Despite intentions, many respondents identified barriers to involvement that included lack of time, expertise, awareness, and subject specific skills that could influence partnerships formation. One respondent wrote, “In my school we just don't have anyone with health-related background to get this started. The most would be individual faculty's research interest, but that won't qualify them to start an educational health-related program.” In addition, several respondents indicated gatekeeping in some form, some from the LIS field. For example, “There are over 60 accredited MLIS programs. Not all need to offer health informatics. It can be a specialty offered well by a few institutions.” While outside the field, a few thought

LIS may not be a good match or could not see the relevance in LIS being involved, such as “[LIS/iSchools are] Less relevant than in past...lack of healthcare contextualization makes these schools less relevant.” One way to create partnerships and bridge gatekeeping gaps may be focusing on HRI topics not being currently taught or emphasized. When asked about gaps, areas mentioned were research data management, data science, research related skills, and even telehealth—areas that libraries and iSchools are currently involved in.

Academic unit positioning could influence educational offerings and partnerships as well. For example, one respondent wrote, “Well, it depends on their faculty. Health informatics is in our medical school, but it could very easily be located within ours if we were not positioned within the College of Education.” This links to comments about what LIS/iSchools philosophy and values bring to informatics education such as “Broadening definitions and opening minds so that the health information world will see a wider set of informational competencies as relevant in the health or medical domain.” A 2018 study of LIS and iSchools on where they are located within their university and analyzing programs’ curriculum showed that there was “limited evidence” of including courses or subjects from other disciplines (Goulding et al. 2018). But partnerships can also complicate the marketing and promotion of HRI education as well, especially since potential students rely on academic program websites to determine if the educational programs have what they are seeking. HRI offerings that result in degrees or certificates can “track” students into the partnered courses. For stand-alone courses this could be a considerable challenge.

Going forward, LIS/iSchools will need to ask themselves in-depth questions about their HRI education involvement both from a practitioner standpoint and as an information science educator. Should only certain schools specializing in health sciences librarianship and/or HRI participate? If they choose not to be involved or partner, how does LIS redirect to HRI offerings by other disciplines? If so, how do LIS programs expose students to a specialized field that students could feel is out of their reach, especially if LIS schools are not offering anything in health sciences librarianship? Will this make health sciences librarianship become a niche specialty? Perhaps these are being offered at institutions that do not have a LIS or iSchool. Moore outlines the process of building a bioinformatics community of practice, which may serve as a model for an individual institution answering these questions (Moore, Vaughan, and Hayes 2004).

Addressing LIS/iSchools as an educator, programs should consider offering certificates or advanced degrees that librarians can take to build upon their skills. The Network of the National Library of Medicine (NNLM) was mentioned as a partner by respondents. Programs offering HRI could collaborate or ask NNLM for funding to offer educational initiatives. At a higher level, this could also be an opportunity for a partnership between NLM and health sciences librarianship organizations such as the Medical Library Association and Canada Health Libraries Association in offering continuing education. Offering a diverse range of educational offerings will meet librarians’ professional needs.

Limitations

This study looked at HRI programs at institutions that had an ALA-accredited LIS/iSchools program, not all HRI programs within North America. The number who indicated they were not involved in HRI was lower than expected, possibly because they may have disregarded the survey, not realizing that there were questions about reasons for non-involvement.

Delineations between HRI types sometimes seemed arbitrary. It is possible some offerings are only named so as a “marketing” advantage. Thirteen different informatics types were identified. Types that could be subsets of one another were not collapsed (i.e., biomedical informatics into bioinformatics).

Pre-requisites or other barriers to taking courses were also not examined. It was difficult to determine which academic unit provides the educational offering. Courses and degrees are usually searchable, but there is no indication of which college, department, program, and/or other entity is responsible for the content and teaching. There can be a mismatch between the degree name and the corresponding course codes and the departments associated with the degree or course.

Conclusions

This study shows that there is still a wealth of partnership opportunities in HRI. Those that currently provide HRI are taking on multiple roles and responsibilities without expectation of their situations changing. As the information landscape grows more complex, partnerships must be formed among disciplines to address gaps and advance curricular content. HRI offerings need to evolve beyond isolated courses toward building foundational skills and enhancing professionals’ skills sets. Health sciences curricula encompasses a wide interdisciplinary topics range, emphasizing the need for improved information management skills and providing an opportunity for library partnership (Olmstadt and Hannigan 2000). Respondents indicated areas where they were hoping to grow strategically such as research data management and data science. American Library Association-accredited and iSchools can make valuable contributions to fill these gaps in HRI education.

Professional organizations need to collaborate with institutions and their LIS/iSchools to provide guidance and standards. Health-related informatics programs that have developed strong partnerships and curricula could be used as models towards standardizing educational content that align with these professional competencies. Perhaps this would mean the development of cross-institutional partnerships that would include technological support at institutions without existing infrastructure or a medical school. Workforce grants could also be developed to encourage these partnerships.

As much as we anticipated more engagement in subdisciplines, most education addressed HRI broadly rather than by specific disciplines. Knowledge of the

subdisciplines within biomedical informatics allows librarians to be expert partners in education and research. Still, the foundation of these partnerships needs to be initiated and maintained over time to provide the most effective programming opportunities. The responsibility of providing the resources, infrastructure and laying the groundwork for partnership with health sciences education often falls to the librarian (Cleveland 1995). Health-related informatics needs to acknowledge the importance of librarians' roles in their curricula and educational offerings due to a shared responsibility in educating future health sciences professionals on locating and managing diverse information types.

Future research on LIS/iSchools participation in HRI education could include a crosswalk analysis of professional competencies to information science frameworks, such as the ALA Framework for Information Literacy for Higher Education (<https://www.ala.org/acrl/standards/ilframework>), the Medical Library Association Competencies for Lifelong Learning and Professional Success (<https://www.mlanet.org/p/cm/ld/fid=1217>) or Competencies for Librarians in Canadian Research Libraries (<https://www.carl-abrc.ca/wp-content/uploads/2020/09/Competencies-Final-EN-1-2.pdf>) that would help design or integrate education opportunities where LIS/iSchools want to be involved. Even though librarians and informationists may receive training in HRI resources and are partnering in educational and institutional initiatives, there has been a lack of recently published literature highlighting examples, as seen in the literature review above. Further research is also needed about the change in HRI education opportunities over time. This research only provides a snapshot. Relatedly, current literature on the intersection of LIS/iSchools consists of descriptions of HRI education efforts. More could be done to evaluate student learning of HRI principles and the effect that LIS/iSchools instructors have on student learning.

ALA-accredited programs and iSchools participate in HRI education but not to the level they could be. The most notable collaboration is between the National Institutes of Health, NLM, and the National Center for Biotechnology Information. These entities provide some of the most comprehensive HRI databases that currently exist and collaborate to provide education and training to all. While this serves as example of what is possible, this is not yet realized on a smaller scale at individual institutions.

Supplemental Content

Appendices A, B, and C

An online supplement to this article can be found at <https://doi.org/10.7191/jeslib.2022.1228> under "Additional Files".

Data Availability

The data and related materials are available in INDIGO, the institutional repository for the University of Illinois Chicago. (Website data: 10.25417/uic.19163753. Survey instrument: 10.25417/uic.19161983. Survey data: 10.25417/uic.19164125.)

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