The Role of Health Information Management Professionals in the Use of Geographic Information Systems

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Abstract

In recent years the use of geographic information systems (GIS) in healthcare has expanded rapidly. Although the use of GIS has increased quickly, very little consensus has been reached on which healthcare professionals are best suited to be trained in and use GIS. A moderate amount of research has addressed the use of GIS in healthcare, but very little research has addressed selecting and training healthcare professionals in the area of GIS. As the use of GIS becomes more closely tied to electronic health records (EHRs), the thought arises that those best versed in EHRs, health information management (HIM) professionals, would be best suited to take on the GIS role. This mixed-methods study explored the current status of HIM professionals' role in GIS as well as the extent to which GIS is being taught in health information educational programs. Although the findings indicate that few HIM professionals are currently using GIS in their jobs and few HIM programs are currently teaching GIS, there is interest in GIS in the future for HIM professionals and in HIM educational programs.

Keywords: geographic information systems; GIS; health information management; electronic health records

The use of geographic information systems (GIS) in healthcare dates back to 1854. In that year, John Snow used mapping, a basic GIS technique, to determine that a large London cholera outbreak was due to contaminated water at a specific water pump. John Snow started using maps in a way that is still being done today. However, tracking the sources and progression of disease is only one use for GIS in healthcare today.

GIS has progressed to cover a multitude of functions in the healthcare industry. In healthcare, the two main types of GIS are epidemiological and healthcare delivery. Epidemiological GIS focuses on health outcomes and patterns or trends of disease. Healthcare delivery GIS focuses on healthcare utilization and access, distribution of services, allocation of resources, disparities in care or access, and strategic planning. Healthcare delivery GIS can also focus on clinical issues, including clinical decision support. With the growth of the use of electronic health records (EHRs) and the resultant large quantities of data, the use of GIS in healthcare has grown considerably in recent years.

Because much of the data used in GIS comes directly from the EHR, health information management (HIM) professionals' role in the use of GIS needs to be determined. In conjunction with this is the need for GIS to be taught in HIM educational programs. In order to address these issues, this study was completed to provide further insight into the use of GIS in healthcare facilities as well as how GIS is taught in HIM programs.

Background of the Study

The role of GIS in healthcare has expanded greatly in recent years. With recent initiatives such as "healthy cities,"[1] the need for healthcare professionals qualified in GIS has risen sharply. Although a moderate amount of research has addressed the role of GIS in healthcare, very little research has looked at which healthcare personnel should take the lead in using GIS. No research has examined the role of HIM professionals in the use of GIS. Therefore, this study builds on existing research by examining the role of HIM and the need for GIS education in HIM and health informatics (HI) baccalaureate and master's programs.

Conceptual Framework and Rationale for the Study

The conceptual framework for this study is based on the need for personnel qualified in both GIS and healthcare to advance the use of GIS in healthcare. This need is outlined by Fradelos et al. in their article "Health Based Geographic Information Systems (GIS) and Their Applications."[2] As stated previously, the use of GIS in healthcare has grown dramatically in recent years across the United States and around the globe. Very few individuals are adequately trained in GIS and healthcare. The need for such individuals is great. Very little research has been done regarding the most appropriate healthcare personnel to take on GIS roles. However, as geographic information systems become more closely tied to EHRs, the natural inclination would be to have those best versed in EHRs become trained in GIS as well. Those individuals would be HIM professionals. Appropriately trained HIM professionals could very easily fill the GIS healthcare gap. This study is needed to assess the current status of HIM professionals in GIS and to assess the need for GIS training in HIM educational programs. In this study, the research objectives were stated in terms of questions used for exploratory purposes:

1. What is the current role of HIM professionals in GIS?
2. How extensively is GIS being taught in health information educational programs?
3. At what level (bachelor's, master's) is GIS being taught in health information educational programs?
4. Are new HIM graduates using GIS on the job?

Review of Related Literature

According to Fradelos et al., "Geographic information systems (GIS) are spatial data management systems . . . that can integrate, store, adjust, analyze and arrange geographically-referenced information."[3] In healthcare, GIS can be used for many purposes from both public health and healthcare delivery standpoints. GIS is the perfect tool to help meet the goals of high-quality, efficient, and cost-effective healthcare. The use of GIS in conjunction with EHR data provides valuable information that can help healthcare providers from both the business and clinical standpoints.

GIS in Healthcare

GIS can provide valuable information for healthcare business practices such as "strategy, capital planning, public health administration, marketing, and operations."[4] GIS enables healthcare administrators to see where their patients come from and what population their facilities serve. Healthcare administrators and practitioners can use GIS to "see where the community resources are in proximity to their patients such as therapy providers, home health agencies and pharmacies. This information is beneficial for patients in rural locations who need care and for a community to access [sic] the need for expanding resources or seeing where there is a need for a certain resource they might lack."[5] Healthcare providers can use GIS to analyze and understand disease patterns as well as the need for access to healthcare services. Studies involving conditions such as "asthma and diabetes, . . . 'ambulatory care sensitive' [conditions], . . . [in which] hospitalization is largely preventable by timely and appropriate primary and preventive health care,"[6] point to the need for increased access to primary care providers in a

particular area. This can improve both quality and efficiency of healthcare in these areas. "Increasingly, GIS is being used to map and explore geographical variation in need for health services and to develop innovative indicators of health care need."[7] When tied with the growing availability of data from EHRs, "health needs data will be incorporated in GIS-based decisions support tools that allow communities and decision-makers to examine questions of health care needs, access, and availability."[8] Analysis of healthcare needs, patient access, travel needed for access, and utilization can be accomplished through the use of GIS. The findings of such analysis can aid in allocation of resources, strategic planning, and marketing.

"Public health uses of GIS include tracking child immunizations, conducting health policy research, and establishing service areas and districts."[9] Beyond these basic uses of GIS in public health, "GIS is being used to create better measures of geographical access and to analyze geographical inequalities in access as well as those patterned along social and economic lines."[10] Disparities and inequalities in access can be identified using GIS, and public health efforts can be focused in these areas. This approach can be used not only for healthcare services but also for other entities that affect health. For example, "GIS can be used to evaluate 'food deserts,' i.e., places within the country (urban or rural) that do not have access to nutritional food or [in which] something stands in the way of nutritional choices."[11] Once these underserved areas are identified, further inquiries can be made to determine why the disparities exist and how they can be overcome. GIS can also be used during disasters to "provide outreach to disaster victims."[12] A study by Simpson and Novak (2013) found that using GIS in disaster management enabled the identification of patients with chronic illness who might not have access to needed resources during a disaster. "Technology can enable health care systems to reach out to patients to facilitate maintenance of health and illness management routines, and improve long-term health. . . . [This would allow] practitioners to be more proactive in their support of patient health during a disaster."[13]

From the healthcare delivery standpoint, Berke (2010) goes as far as to state that "place becomes a vital sign" and that "with the integration of health information and GIS, it is possible to envision data in an electronic health record pertaining to location, nearest places for exercise or healthy food, social services, measures of walkability, and other data important in promoting healthy lifestyles."[14] He states that "because we spend 100% of our time somewhere, it is reasonable to expect that place matters when it comes to our health."[15] Environment and availability of resources close to home have a direct effect on health. Other "examples of spatially measurable variables that can have an impact on health include air pollution levels, temperature, crime rate, socioeconomic status, distance to affordable or healthy food and public transportation."[16] Understanding the "place" and environment of patients enables healthcare providers to understand their patients better and to better address their healthcare needs. In a study of diabetes management, it was found that "prescribing practices and collection/dispensing of self-testing glucose strips vary widely across areas of different population density."[17] Using such information "can enable us to provide (or at least aim for) self-care support best tailored to the geographical location of the patient and the type/severity of the disease."[18] Healthcare providers can also use GIS for services that require travel coordination, such as home health, emergency resources, and even "patient care and room management."[19] GIS can provide "patient-specific data on the social and environmental determinants of health [which] may prove an essential catalyst for improving patient outcomes."[20] In this way, GIS can help meet the requirements of the Affordable Care Act and improve personalized medicine.

Researchers have used GIS in recent studies to evaluate disease distribution and disease trends and have found some interesting and unexpected results. McLafferty and Wang (2009) used GIS to analyze the distribution of late-stage cancer in Illinois. In spite of the fact that "conventional wisdom suggests that rural residents have a higher risk of late diagnosis because of numerous barriers to obtaining preventive health services and screening for early detection,"[21] they found that "the risk of late diagnosis is greatest among patients living in the City of Chicago."[22] The use of GIS in the research setting can help healthcare administrators and providers discover such trends and work to alleviate such disparities and inequalities.

GIS and the Healthcare Labor Force Shortage

In spite of the fact that GIS has such far-reaching capabilities in healthcare, a significant gap exists between the supply of and demand for individuals trained in both GIS and healthcare. The use of GIS is

growing across many industries. In 2008, the US Bureau of Labor Statistics stated that "geographic information specialists [are] in the occupational groups that are expected to grow by twenty-one percent or more from 2006 to 2016, much faster than average."[23] In 2015, the US Department of Labor stated that the geospatial technology "market is growing at an annual rate of almost 35 percent, with the commercial subsection of the market expanding at the rate of 100 percent each year."[24] GIS has similarly grown in the healthcare sector, in both public and private health. The need for GIS professionals to meet this demand is growing; however, one of the challenges of GIS in healthcare is finding professionals with both healthcare and GIS knowledge. While many healthcare facilities that use GIS use individuals trained on the job, "workforce readiness in this evolving technology will continue to demand more than on-the-job training to utilize GIS to its full power and capabilities."[25] It has been noted that healthcare facilities, by and large, do not have personnel adequately trained in GIS. To use GIS effectively, healthcare facilities "would . . . require specialized personnel who could understand how to link the GIS data to EHR information for the particular problem at hand, and who may not be readily available to all institutions."[26] While most healthcare professionals lack GIS knowledge, most GIS professionals do not have the required understanding of healthcare. "The public [and private] health sector is a very complex and controversial field. Professionals who are interested in this domain should have critical understanding as regards the correlation amongst factors that affect health."[27]

Gotz, Frates, and Weschler completed a study in California "to determine the needs of the healthcare workforce related to the use, incorporation of, and training needs related to geographic information systems (GIS) within healthcare administration, management, and policy."[28] In identifying the appropriate respondents in the healthcare organization, the researchers found that the contacts were frequently found in "the business development or marketing department, or the information systems department,"[29] but there was little widespread knowledge of GIS throughout the facility. While the majority of respondents stated that GIS was used in their facilities, they further stated that only "between one and three people use GIS as a part of their job function."[30] The researchers found that "according to fifty-four percent of the survey respondents (N=22), as long as the employee can use the technology, no additional qualifications were required in the job function."[31] However, the majority of the uses of GIS noted by the respondents were fairly basic and used publicly available data. Therefore, the researchers noted that "as the use of GIS within healthcare organizations continues to grow and develop, formal training and education specifically targeted to healthcare problems, data, and personnel will be required."[32] In addition, the researchers stated that "educators need to [be] . . . imparting knowledge as well as conducting skills training, in order to ensure that GIS is used responsibly."[33]

Another study assessed the use of GIS in community health assessments. The researchers found that "GIS is not being used enough" and noted that "a possibility for the underutilization of GIS might be the lack of training that public health professionals have with this type of software."[34] They also point to the need for formal education in GIS, noting that "it is important for these [public health educational] programs to implement GIS into their programs and teach students how to use them in a hands-on manner."[35] GIS is making its way into all aspects of healthcare, from business applications to clinical services, and healthcare entities will need to have employees trained to handle all of these GIS applications. Endacott et al. make a case that "nursing can play a key role in demonstrating how various data sources (including GIS) can be usefully integrated to enable informed decision making."[36] In turn, others state that "nursing and nursing research will benefit by adding GIS to their repertoire."[37] As the use of GIS in healthcare continues to grow, the question will further arise as to who should be trained in GIS and who is best prepared to appropriately use GIS in the healthcare setting.

Regardless of how this question is answered, it is clear that additional training will be needed in order to meet the increasing demand for GIS/healthcare trained professionals. Wikle outlines a number of GIS educational programs offered in the United States. These programs include a wide variety of undergraduate and graduate degrees and certificates. While some are traditional face-to-face programs, many are online. The growth in the number of programs "corresponds with the increasing demand for a geospatial workforce that possesses great knowledge and improved competencies."[38] However, these programs are all general GIS programs. As has been discussed, GIS professionals in the healthcare industry will need specialized knowledge and skills beyond just GIS. These individuals will need specific

GIS training in "spatial statistics and epidemiology,"[39] but also knowledge and understanding of electronic health records. They will need to know and understand GIS and also the complexities of health. Skills in information technology, geography, data analysis, and spatial relationships will need to be combined with knowledge of healthcare, public health, health services, disease processes, and other contributors of health.

HIM is an area in which this skill set would fit well. HIM students learn the healthcare system and disease processes as well as information technology and data analysis. Adding GIS courses specific to spatial relationships and geography would be a relatively easy and simple way to train the needed GIS/healthcare professionals. While this seems to be an easy and logical solution to the shortage of professionals trained in both GIS and healthcare, it is not clear that this is currently being done. This study is designed to explore the use of GIS by HIM professionals in healthcare facilities as well as the teaching of GIS in HIM educational programs.

Methodology

Research Design

The research design for this study was a mixed-methods survey design. Two surveys were used for this study. The first was sent to HIM professionals working in the field and was used to assess their use of GIS and/or knowledge of GIS use in their facility. Through quantitative measures, the survey data were used to determine the extent of the use of GIS among HIM professionals in the field as well as by other users of GIS in healthcare facilities and the ties between EHRs and GIS. Further analysis involved assessment of the importance of GIS skills for new HIM employees at these facilities. The second survey was sent to program directors at HIM/HI baccalaureate and master's educational programs. Quantitative analysis was used to determine relationships between the type of educational program and the extent to which GIS was being taught as well as specifically how GIS was taught in various educational programs. Quantitative analysis was also used to determine the program's graduates' use of GIS on the job. Further quantitative analysis assessed the relationship between whether GIS was taught in a program and that program's graduates' use of GIS on the job. Qualitative analysis allowed for further insight into the current teaching of GIS and the need for GIS in HIM/HI curricula.

Population

The population used for the first survey was the members of the Ambassadors to Education group for the HIM program conducting the research. These group members were asked about the use of GIS in the healthcare facilities in which they work. The survey was sent electronically to the 38 individuals in this group via Select Survey.

The population used for the second study was the directors of health information and health informatics programs accredited by CAHIIM (Commission on Accreditation for Health Informatics and Information Management Education). All baccalaureate and master's programs were used because of the small numbers and the expected response rate. The published CAHIIM program directory was used for identification of programs and appropriate contact individuals. This directory includes 332 total programs, 268 of which are associate degree programs, 53 of which are baccalaureate programs, and 11 of which are master's programs. Because GIS is a higher-level skill, surveys were sent to the directors of all baccalaureate and master's programs. The survey was sent electronically to the 64 people in this group via Select Survey.

Instrumentation

The surveys were developed specifically for this study to gather the desired information. The survey sent to the Ambassadors to Education members consisted of eight closed-ended items and one open-ended item (see Appendix A). These HIM professionals were asked questions regarding GIS use at their organization, the users of such information, the oversight of GIS, the education required for GIS users, and the importance of GIS skills for new HIM employees. The survey sent to the HIM/HI educational program directors consisted of eight closed-ended items and one open-ended item (see Appendix B). Contact personnel were asked to answer questions regarding their program and how and whether GIS is

taught in their program. They were also given the opportunity to further comment on related issues that were not included in the survey. The reliability and validity of both instruments was tested through pilot testing. Revisions were made following the pilot test.

Procedure

The survey sent to the Ambassadors to Education was sent in April of 2016 via Select Survey. All Ambassadors to Education for the HIM program conducting the research were sent an email with a cover letter explaining the study and a link to the survey. The survey of HIM/HI program directors was administered in September of 2016 via Select Survey. All contact personnel listed in the CAHIIM program directory were sent an email with a cover letter explaining the study and a link to the survey. The institutional review board (IRB) reviewed the study and survey, and it was found that IRB approval and a consent form were not required. Participants for both surveys were given the option of not participating by not following the survey link. Participants for both surveys were given three weeks to complete the survey; a reminder email was sent after two weeks in an attempt to increase the response rate.

Data Analysis

HIM Professionals' Survey

In April 2016, the first survey was sent to the Ambassadors to Education members asking about the use of GIS in the healthcare facilities in which they work (see Appendix A). The average response rate per question was 31 percent, with as many as 39 percent responding to some questions and as few as 26 percent responding to other questions. In addition, 13 percent added additional comments.

In terms of whether GIS is currently used in these facilities, 53 percent of the 15 respondents stated that GIS was used in their facilities, 20 percent stated that it was not used, and 27 percent stated they did not know whether it was being used. GIS is being used in facilities for a variety of purposes. Table 1 shows the various uses of GIS in healthcare facilities as noted by the 15 respondents.

A variety of departments oversee GIS in these healthcare facilities. Strategic services/planning was most commonly listed (62 percent; 5 respondents). Other departments listed included healthcare informatics, corporate offices, and the executive committee.

A number of GIS software/applications are used for GIS in these facilities/organizations. These include ArcGIS/Esri, Buxton, Dartmouth Atlas of Health Care, Celltrack, GeoAccess, local clinical management systems, and other unknown systems. None of the 15 respondents stated that their facilities used Epi Info/Epi-Map or Altarum.

Thirteen individuals responded to a question regarding whether the GIS system was tied into the EHR system at their facility. Of these respondents, 1 respondent (8 percent) stated that the GIS system and EHR system were tied together. Two more respondents (15 percent) stated that EHR data were used in GIS, 38 percent stated that the two were not tied, and 38 percent did not know if there was a relationship.

In terms of the HIM department's role in GIS, 91 percent stated that there was no HIM department involvement in GIS. In contrast, 9 percent stated that there was some involvement. No respondents stated that there was significant involvement.

The majority of these facilities required GIS users to have either on-the-job training (20 percent) or a college degree (20 percent). One facility (6 percent) required a master's degree. Two respondents (13 percent) were not sure of the requirement.

Perhaps the most important question was how important GIS skills were for new HIM employees at the facility. The majority (40 percent) stated that new HIM employees do not need to learn GIS skills. Only 1 respondent (10 percent) stated that GIS skills were important for new HIM employees. Other respondents were neutral (30 percent) or stated that the skills were not very important (20 percent).

In closing, five respondents (13 percent) added additional comments. While the results of the survey did not show that HIM is highly involved with GIS, respondents stated:

"I can see an application just not sure it is an important skill. Knowledge of the concept for students would be a plus."

"Understanding this data can help HIM professionals leverage their data analytic skills in healthcare. This data can be used in combination with diagnosis/procedure data to help determine health system strategy for additional service lines (where there is a lack of services with the system to support the patient population in certain areas) and to further support patient populations with advanced technological services (i.e., new devices/technology)."

Despite the fact that HIM professionals are well placed to be involved with GIS at their institutions, most respondents to this survey stated that HIM professionals were not highly involved with GIS. However, many respondents knew details about GIS, such as how it was used in their facility, who oversees it, and what software or applications are being used. Some respondents felt that GIS skills could be useful for HIM professionals now or in the future. In addition, an ArcGIS trainer stated: "Ten years ago you'd have someone in GIS learning about healthcare but today you have people in healthcare learning GIS" (personal conversation, May 4, 2016). This comment, as well as other comments from the survey respondents, suggest the need for further investigation of the potential for HIM involvement with GIS in healthcare. With the emphasis on data analytics in HIM, knowledge of and involvement with GIS is a valuable asset for HIM professionals.

HIM/HI Program Directors' Survey

In September 2016, the second survey was sent to the program directors in all CAHIIM accredited baccalaureate and master's HIM and HI educational programs. The survey was sent to 64 program directors, and 29 responded, for a response rate of 45 percent. Of the 53 surveys sent to baccalaureate programs, 25 were returned (47 percent response rate) and of the 11 surveys sent to master's programs, 4 were returned (36 percent response rate). Overall, 86 percent of the programs responding were baccalaureate programs, and 14 percent were master's programs. All surveys returned were complete and were included in the analysis.

An analysis of the data submitted overall reveals that GIS is taught in only 2 (7 percent) of the 29 responding HIM programs. These two programs are both baccalaureate programs that include GIS in one of their courses. In one program, GIS is taught by HIM/HI faculty and is not a separate subject but is included with other subjects, such as statistics and population health. In the other program, GIS is also included in another course; however, this course is taught by computer information systems faculty and is taught for nonhealthcare applications. Four of the responding programs (14 percent) are considering adding GIS to their HIM/HI curricula. The majority (79 percent) are not teaching GIS or considering it for the near future. The two programs that are teaching GIS are teaching ArcGIS/ESRI. One of the programs that is considering adding GIS to their curriculum is planning on teaching ArcGIS. Three of the programs that are considering adding GIS to their curriculum are baccalaureate programs, and one is a master's program.

An analysis of the perceived use of GIS by program graduates as well as the value of teaching GIS in HIM/HI followed. Respondents were asked to address the issue of whether the program graduates use GIS in their jobs using a five-point Likert scale (1, strongly agree; 2, agree; 3, neutral; 4, disagree; 5, strongly disagree). The overall mean score for "Program graduates use GIS in their jobs" was 3.38 (neutral); the mean was 3.39 for baccalaureate programs and 3.33 for master's programs. Respondents were asked to respond to the issue of the importance of teaching GIS skills in HIM/HI based on a three point scale (1, important; 2, neutral; 3, not important). The overall mean for "In this program teaching GIS skills is seen as" was 2.10 (neutral); the mean was 2.13 for baccalaureate programs and 2.00 for master's programs.

ANOVA was performed and showed no statistically significant difference between baccalaureate and master's program directors in the perceived use of GIS skills by HIM professionals. ANOVA also showed no statistically significant difference between the two groups in the importance of teaching GIS

skills in HIM/HI programs. Chi-square tests also found no statistically significant differences in these areas.

A qualitative analysis was completed on the additional comments (n = 11). Many (46 percent) of the respondents felt that GIS is an important topic for HIM/HI students and it is being taught in the program or students are at least introduced to it or made aware of it. Thirty-six percent of the respondents stated that GIS is an emerging issue and, although it is not yet taught in their programs, there may be a need to teach it in the future. One respondent (9 percent) stated that GIS should be covered in master's programs. Finally, another respondent (9 percent) felt that GIS is a public health issue and not an issue related to HIM. Select specific comments were as follows:

"I think this is an important topic due to the population health reporting for EHRs."

"There are data analytics jobs open and this provides opportunities for HIM graduates with this skill set."

"I think that awareness [of GIS] is essential to the development of future HIM professionals."

"It is something we have considered but currently do not have the extra room in the curriculum and feel it is still an emerging issue."

Very few educational programs currently included GIS in their curriculum, and few program directors felt that it was important to teach GIS skills in their program. Also, few respondents agreed or strongly agreed that program graduates were using GIS in their jobs. These findings did not differ significantly between baccalaureate and master's programs.

However, the comments returned did show an obvious interest among some respondents regarding GIS in the future of HIM/HI. One explanation for the current lack of interest in teaching GIS in HIM/HI programs is that programs are in the midst of revising curricula to meet the new required CAHIIM competencies that go into effect in 2017. One respondent even stated, "GIS is not included in the entry-level competencies." With a focus on meeting the new requirements, most programs that are not currently teaching GIS are not looking at adding anything beyond the CAHIIM requirements at this point in time. The comments do show some interest in adding GIS to curricula in the future. As programs adjust to the new CAHIIM competencies after 2017, more programs may start looking to new avenues in the future of HIM/HI, including GIS. In addition, as GIS needs continue to grow, more HIM professionals and HIM/HI program directors may become aware of the need for GIS-trained healthcare professionals, thus increasing the interest in teaching GIS to HIM/HI students.

In reviewing the data in terms of the research questions, we found that HIM professionals do not currently have a large role in GIS within their institutions. GIS is not currently taught in the majority of HIM/HI educational programs, and the programs in which it is taught are baccalaureate programs. Finally, most new HIM graduates are not using GIS on the job. As noted above, however, the comments on the professionals' survey indicated a belief that GIS skills might benefit HIM professionals in the future. In addition, HIM/HI educational program directors indicated that there might be a need for teaching GIS skills in these programs in the future.

Limitations and Recommendations for Future Research

The survey of HIM professionals' was completed with a relatively small sample size, and the sample was not very diverse. The Ambassadors to Education group members who were surveyed were all from one educational program and from one geographical area. In addition, the low response rate resulted in an even smaller sample size, and the high number of "do not know" responses resulted in further limitations. These limitations reduce the ability to draw strong conclusions on the basis of this single study.

Further research is needed to fully determine the role that HIM should play in GIS. A follow-up study using a larger and more diverse health information services workforce sample should be done to further assess HIM professionals' use of and experience with GIS. Another recommendation for future research would be to survey hospital administrators because they would be more knowledgeable about the use of GIS in their facilities and about which personnel are best suited to work with GIS. While this study is a starting point, further information about the use of GIS and the involvement of HIM professionals in GIS is needed to more completely analyze the future of HIM professionals in GIS.

Conclusions

Currently, most HIM professionals are not highly involved with GIS in their institutions, and most HIM/HI programs do not include GIS skills in the curricula. A review of the literature, however, shows that a large gap exists between the need for GIS professionals in healthcare and the supply of such personnel. This gap is projected to grow larger in the coming years. Despite the current lack of HIM involvement in GIS and the lack of GIS in the curricula, there are subtle changes indicating that HIM professionals may be called into the GIS arena in the future. Some HIM professionals have been called to learn GIS on the job and step into this new arena. L. Frederick (personal communication, October 24, 2016), an operations improvement leader at a midsized midwestern medical center, is one such HIM professional. Although he never received any formal training in GIS, he started working with GIS while completing his bachelor's in HIM. Now he is involved in a GIS project evaluating the use of the emergency room for nonemergencies. By matching emergency room visits having an emergency severity index of 4 or 5 (considered nonemergencies) with patient addresses, Frederick was able to identify hot spots, or areas in which large numbers of patients were using the emergency room for nonemergencies. Frederick is now involved in evaluating the need for urgent care centers in these areas. Frederick feels that his HIM background and health data analysis skills are a natural fit for such GIS projects.

In addition, some HIM/HI programs have expressed interest in adding GIS to the curriculum in the future. New HIM professionals trained in GIS at the college level will be well prepared to step into GIS jobs. As more HIM professionals work with GIS, the healthcare industry will see that these HIM professionals fit perfectly into the growing gap of GIS expertise in healthcare. The results of these surveys provide a starting point for the HIM profession in looking at another path for its members. With the ties between data analytics and GIS and the current intense focus on data analytics in HIM, GIS may very well be the logical next step in the growth of the profession.

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Appendix A

Ambassadors in Education Survey Instrument

I am conducting a study to explore the use of Geographic Information Systems (GIS) in healthcare facilities and in conjunction with Electronic Health Records (EHR). I am requesting your participation, which will involve completion of one anonymous online survey. This will take you 5-10 minutes to complete.

Please answer the following questions about the healthcare facility/organization in which you work. Your answers will be submitted anonymously.

1. Are Geographic Information Systems (GIS) currently used in your facility?

Yes
No
Unknown

2. What is GIS used for in your facility? Please check all that apply.

Marketing
Strategic Planning
Coordination of Services
Capital Planning
Operational Analysis
Emergency Preparedness
Epidemics/Surveillance/Management of Disease
Other, please specify

3. Who oversees GIS in your facility? Please list department.

4. What software/applications are used for GIS in your facility?

ArcGIS/Esri
Epi Info/Epi-Map
Altarum
Dartmouth Atlas of Health Care
Other, please specify

5. Does the GIS system tie into the EHR at your facility?

Yes
No, but EHR data is used in GIS
No
Unknown

6. What is the Health Information Management department's level of involvement with GIS at your facility?

Significant
Some
Minimal
None

7. What educational qualifications does your organization require for GIS users?

On the job training
Some college
College degree
Some post-graduate education
Master's degree
GIS certificate
If college or master's degree, in what area?

8. How important do you feel that it is for HIM students to learn GIS skills?

9. Other comments:

Appendix B
Health Information Management/Health Informatics Program Director Survey

I am conducting a study to explore the teaching of Geographic Information Systems (GIS) in Health Information Management or Health Informatics educational programs. I am requesting your participation as an educator, which includes completion of one 8 question anonymous online survey. This will take you 5-10 minutes to complete.

Please answer the following questions about the Health Information or Health Informatics program in which you teach. Your answers will be submitted anonymously.

Please be sure to click "Done" when finished with this survey so that your answers will be saved and submitted.

1. What degree level is this program?
   a. Associates
   b. Baccalaureate
   c. Masters

2. Is GIS taught in this program?
   a. Yes
   b. No
   c. No, but it is being considered

3. If GIS is taught in the health information program, how is it delivered within the curriculum?
   a. Full course(s)
   b. Included in another course
   c. It is not taught

4. If GIS is taught in the program, who teaches it?
   a. It is taught by HIM/HI faculty
   b. It is taught by another department, please specify _____
   c. It is not taught in the program
   d. Other, please specify _____

5. If GIS is taught in the program, what software/applications are used/taught?
   a. ArcGIS/ESRI
   b. Epi Info/Epi-Map
   c. Altarum
   d. Dartmouth Atlas of Healthcare
   e. Other, please specify _____

6. Please select the appropriate response. Program graduates use GIS in their jobs: (rate 1-5)
   1. Strongly agree
   2. Agree
   3. Neutral
   4. Disagree

5. Strongly disagree

7. In this program teaching GIS skills is seen as:
    1. Important
    2. Neutral
    3. Not important

8. Other Comments:

Table 1

Uses of GIS in Healthcare Facilities (*n* = 15)

Function	Response Total	Response Percentage*
Marketing	4	29%
Strategic planning	5	36%
Coordination of services	2	14%
Capital planning	4	29%
Operational analysis	6	43%
Emergency preparedness	3	21%
Epidemics/surveillance/management of disease	3	21%

**Note:* Respondents could choose more than one response. Response Percentage refers to the percent of respondents choosing the listed use as one of their responses.