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Information Systems and Healthcare XXXV: Health Informatics Forums for Health Information Systems Scholars

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Abstract:

The use of technology in health care settings is an area of increasing interest to information systems researchers. An awareness of journals and conferences that focus on this innately interdisciplinary field is necessary if researchers in related domains, such as information systems, intend to connect methodologies, insights, and perspectives to advance health IT knowledge. This study fills a void in the literature by providing an initial peer ranking of dedicated health informatics journals and related conferences as guidance for those interested in learning more about and/or publishing in this field. Results indicate that there are at least forty-five journals that researchers may want to consider in conducting health informatics work.

Keywords: health informatics, healthcare, health informatics journals, journal ranking, conference ranking, interdisciplinary

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I. INTRODUCTION

Healthcare continues to play a significant role in the social and economic aspects of today's society, and the effective use of information technology (IT) is an integral part of current healthcare initiatives [Chiasson et al., 2007]. Significant increases in federally sponsored and private health IT (HIT) spending since 2007 have generated interest in the effects of these technologies on the healthcare industry in terms of cost structure, healthcare quality, and the possibilities offered by "e-health" to provide access to healthcare, especially through telemedicine, electronic health records, advances in data analytics, and remote patient monitoring. In response, the emerging research domain of health informatics focusing on these and related topics is growing at a rapid pace.

Health informatics is a multidisciplinary field with contributions from many academic disciplines, especially medicine, informatics, computer science, public health, and sociology [Shortliffe and Blois, 2006]. A number of topics in health informatics have been examined in each of these domains of research. The use of technology in healthcare settings is an area of increasing interest to information systems researchers. In fact, it has been suggested that an exchange of information between health informatics and information systems publication outlets would both facilitate the diffusion of IS theory into the domain of health informatics research and enrich the development of IS theory [Chiasson et al., 2007]. This raises the question of how we can bridge the respective domains to connect methodologies, insights, and perspectives to advance health IT knowledge in research and practice. Cross-pollination of insights and perspectives among journals and conferences with a focused interest in health informatics is one means of bridging the domains to facilitate innovative ideas.

In academia, researchers often face the critical choice of identifying journals appropriate to their research for reference, understanding, and inspiration and as potential outlets for manuscripts. Researchers often restrict their focus to mainstream journals within their chosen field. Unfortunately, the emerging interdisciplinary field of health informatics and related areas may make it difficult to match the research being performed with journals that currently exist in established fields of study. This could be a costly gap, because focused health informatics journals would seem to augment what is found in journals in a researcher's "home domain" with additional important sources of information about prior research and appropriate potential outlets. However, identifying quality journals in a new interdisciplinary field may be particularly challenging (e.g., see the challenges enumerated by Bharati [2002] in discussing publication in the emerging field of E-commerce). Lack of awareness may be one issue, especially in silo contexts where researchers are not generally exposed to interdisciplinary publication outlets. In addition, although the choice of journals depends on a number of factors, the quality of the publication outlet remains an important criterion, and independent assessments of quality may be difficult to determine in an emerging interdisciplinary field.

A number of methods have been used to assess the quality of the journals, including ranking by professionals in the field [Hardgrave and Walstrom, 1997] and the use of impact factors [Shewchuk et al., 2006]. It is generally accepted that the journals with the highest impact factors are the most prestigious ones; the associated perception might be that the journals with the highest impact factors are those for which it is most difficult to have an article accepted. However, the use of impact factor alone may be shortsighted, particularly in an up-and-coming field.

The concept of impact factor was first created to help select additional source journals simply by converting the author citation index to the journal citation index. The concept has evolved to describe both journal and author impact. A journal's impact factor is based on two elements: the numerator, which is the number of citations in the current year compared to items published in the previous two years, and the denominator, which is the number of substantive articles and reviews published in the same two years. There is a skewed distribution of citations in most fields. Specifically, factors such as manuscript refereeing, processing delays in the appearance of articles on the same subject in the same issue all affect the impact factor [Garfield, 2006]. Other objections to impact factors are related to the system used in the Journal Citation Reports to categorize journals. Regarding healthcare journals in particular, many healthcare management journals are not grouped in the same category [Garfield, 2006, Shewchuk et al., 2006]. There is a widespread belief that the size of the scientific community that a journal serves also significantly affects the impact factor [Garfield, 2006]. Thus, it would be fair to assume that journals in new and emerging fields, such as health informatics, with a growing number of journals and community members would take some time to attain high impact.

Over the past few years, a number of researchers have assessed the quality of IS journals by using methods to rank, rate, and value IS research journals, employing methods such as perceptions of an elite group of researchers

and perceptions of a representative group [e.g., Hardgrave and Walstrom, 1997; Peffers and Tang, 2003; Walstrom et al., 1995]. Although such IS journal rankings exist, a journal ranking of the wide spectrum of IS journals may be necessary but not sufficient for researchers doing work in interdisciplinary areas to fully understand possible outlets for their work. First, such listings may include journals that are not appropriate for interdisciplinary work. Second, such listings may exclude specific journals dedicated to interdisciplinary fields that are important additions to the literature review and theoretical development as well as potential journals for manuscript submissions. Finally, an interdisciplinary focus may change the perception of how to assess quality. For example, in a study of preferences of journals for E-commerce research, it was found that the perceptions of journals as being appropriate for E-commerce research differ from those for typical IS research [Bharati and Tarasewich, 2002]. It is also of note that this same study found that many of the newer, dedicated E-commerce topical journals compared favorably in terms of appropriateness and quality against traditional IS journals. Thus, to comprehensively consider likely prior research sources and outlet options for research related to technology applications in healthcare settings, it seems prudent to review rank listings of health informatics journals in addition to rank listings and impact factors for related fields.

Conferences often offer an "initial airing" of work that is later refined for journal publication and also plant seeds for future studies and collaborations. Thus, it is also important to consider the ranking of conferences, especially due to constraints on time and resources for conference participation.

A search of information systems and health informatics journals did not produce any such peer ranking of health informatics journals and/or conferences. Thus, the purpose of this article is to fill the void in the literature by providing an initial peer ranking of journals specifically designated as health informatics journals as guidance for those interested in learning more about and/or publishing in this domain. Next, we discuss our survey method, followed by the results and discussion of those results.

II. METHOD

We developed an Internet-based survey to gather data and an automated tool that can send personalized e-mails for recruiting participants. Given that the target audience was composed of professionals actively involved in health information technology (IT) research who use the Internet as a tool for their work, the medium used for data collection was appropriate to the study. The data collection instrument used for this study was a modified version of the survey questionnaire used in the study by Hargrave and Walstrom [1997] for the domain of general information systems. The survey asked respondents to rate 44 journals using a five-point Likert-type frequency-based scale with the values "0=Unfamiliar with HIS articles in this journal (or conference)," "1 = Not appropriate as a publication outlet," "2 = Appropriate as an outlet for publication," "3 = Significant as an outlet for publication," and "4 = Outstanding as an outlet for publication." The survey also asked respondents to rate seven conferences using a four-point Likert-type scale with these values: "1 = No value to the health informatics field," "2 = Little value to the health informatics field," "3 = Valuable to the health informatics field," and "4 = Very valuable to the health informatics field." Journals and conferences were presented in alphabetical order. In addition to simple instructions, the survey included contact information for a researcher who was available to answer questions, as suggested by Boynton [2004].

The list of forty-four journals was obtained by using four different approaches. First, we conducted an Internet and "snowball personal contact" search to find suggested or required journals that Health Information Systems (HIS) departments (around the world) considered necessary for tenure promotion and/or career goals. To perform a "snowball personal contact," we asked personal contacts if their department had a published or implied list of appropriate HIS journals and if they would share the names of those journals. We also asked if they knew of any schools other than their own that might have such lists and if they could provide us with a contact at that school. We then made contact with the referral and proceeded in this fashion until we received no additional names or departments to contact. We did not contact any department more than once. We then carried out an Internet search with the following search terms: "Health informatics journal," "Health information systems journal," "Health technology journal," and "Health IT journal." Third, we selected journals that belonged to the following Social Sciences Citation Indices (SSCI) categories: Information Systems, Medicine, General & Internal, Health Care Sciences & Services, Medical Informatics, Health Care Sciences & Services, Computer Science, and Interdisciplinary Applications. Fourth, we worked with a trained medical school librarian to determine whether there were omissions based on her resources. Finally, we allowed respondents to suggest additional journals and their respective ratings beyond the original forty-four journals that resulted from the procedures described above.

We excluded declared (per journal scope statements) "pure" biotech- and bioengineering-type journals, which are often set apart as highly specialized fields when defining the health/biomedical informatics domain [Shortliffe and Blois, 2006]. No attempt was made to separate academic from "academic/practitioner mixed audience" journals in the resulting list to remove researcher bias that might be present in making this distinction and to allow respondents to determine the value of each journal as a publication outlet without the bias toward an academic-only target

audience. Given the general importance to the medical profession of new findings and new technologies and the need for researchers to understand practice, the distinction between practice and academic journals, outside of peer review, is not absolute and is not clearly defined on journal websites. From what we could discern from published information covering the scope of the journals and submission requirements, the majority of journals in our list seem to contain at least some peer-reviewed articles. One noted example is *Linux Med News*, which provides articles that tend to target a professional practicing health and health administration audience. The contents and articles do not present methodology and are not peer-reviewed. However, the articles are published within a significantly shorter time after submission than in a more academic journal. Such outlets may be helpful to authors who want to reach practitioners quickly to provide recently updated information on new health informatics systems and or initiatives. In contrast, publications such as the *Journal of the American Medical Informatics Association* provide content that appears to target a more academic research audience. Some journals, such as *Telemedicine and e-Health*, seem to blend content to suit both audiences with a mix of peer-reviewed and other articles.

The list of six conferences was obtained through an Internet search using the following search terms: "Health informatics conference," "Health information systems conference," and "Health care IT conference." We then screened the results for indications that the conference (or, for one result, a sector of the conference) was dedicated to health informatics and welcomed academic research papers and that the event was recurring.

The survey was custom-developed in PHP. We installed this application on a Unix-based web server hosted by a Midwestern university's computing center. Dillman et al. [1998] found that surveys on relatively plain web pages that loaded quickly resulted in higher response rates than those that took longer to load. Thus, our survey was designed with a plain, simple interface. The performance of the server and its bandwidth capabilities were evaluated before starting the project. We also developed a custom software application to send a personalized e-mail invitation to all of the respondents. Personalization has been reported to be an important element in increasing the response rate in mail surveys [Dillman et al., 1998].

Because our survey was posted on the Internet, we decided to create a relatively complex web address to minimize the number of responses from individuals outside of the targeted sample. Only those who received the e-mail invitation were provided with the web address. The survey was sent to a subset of fifty subjects as a logistical pilot test. Site hits and response rates indicated the participants were able to find the survey online. Hence, the delivery process seemed effective. The results of the pilot did not indicate a need to further refine the survey. The survey was disabled immediately after the close date.

Four primary methods were used to develop an e-mail contact list to invite participation. First, we identified conferences with tracks focused on health informatics (via Internet search, personal knowledge, and special interest groups), and then we either obtained an author list or developed the list by searching for contact information for authors. Second, we performed an Internet search for conference authors' associated academic departments, information systems departments, and academic departments listed by the American Medical Informatics Association in this field. Third, we used a "snowball" (generally used to develop an interview list as in Rothbart et al., 1982) method initiated through personal contacts in this field to develop a personal contact list. We sent invitation letters to department chairs and asked that they inform potential interested faculty of the survey. Fourth, we conducted a web search of all academic departments and academic scholars that referenced health informatics, health information systems, and/or health IT in posted web pages. Based on these efforts, in late 2006 we sent an initial e-mail invitation to 1,336 participants referencing the survey. We did not store any IP addresses or other personal information that could reveal the source computers of the survey responses. No questions that would lead to identification of the participants were asked. E-mail address data were stored behind firewalls on secured computing equipment.

Reminders were sent by e-mail, first three months after we sent out the invitation, then again at seven months. It was not possible to send follow-up reminders specifically to non-respondents, so only general reminders were sent that also directed respondents not to complete the survey a second time. We kept the website running until early 2008.

III. RESULTS

Demographics

A total of 402 site visitors viewed the web survey; however, we received only 129 completed responses (9.7 percent response rate from 1,336 e-mails sent; 32 percent response rate from those who viewed the web survey). A profile of the respondents by rank and degree type is provided in Table 1a, by discipline in Table 1b and by geographic location in Table 1c (responses were not mandatory, and some respondents did not respond to all questions).

Table 1a: Respondents' Profile by Rank and Degree Type			
Rank		**Degree by Type**	
Professor	20.9%	Ph.D.	50.4%
Associate professor	16.4%	M.D.	10.9%
Assistant professor	30.0%	A.B.D.	0.8%
Senior lecturer	1.8%	M.S.	27.9%
Lecturer	2.7%	B.A.	5.4%
Post-Doctorate/Researcher only	10.9%	Other	4.7%
Ph.D. student	9.1%		
Not in academia	8.2%		
Total = 110		Total = 129	

Table 1b: Respondents' Profile by Discipline		
Discipline	**N**	**Percentage**
MIS	27	24.3%
Health and medical informatics	24	21.6%
Computer science	20	18.0%
Medicine	15	13.5%
Management/Organizational behavior/strategy	10	9.0%
Science	5	4.5%
Nursing/Nursing informatics	4	3.6%
Engineering	3	2.7%
Public health	3	2.7%
Total	111	

Table 1c: Respondents' Geographic Location		
Discipline	**N**	**Percentage**
Pacific/Asia	13	12.0%
Europe	23	21.3%
North America	72	66.7%
Total	108	

We also asked respondents for their affiliations with the targeted journals to assess their level of familiarity and indirect assessment of expertise and identification with the field; thus, we were able to further ascertain that we had reached an "elite group," which we defined as those who are active in this interdisciplinary area. Tables 2a to 2c provide details of respondents' affiliation with the journals: sixteen respondents indicated they were editors of one or more of the journals, twenty-eight were reviewers of one or more journals, and fifty-five were authors in one or more journals. Thus, it appears that our respondents were established in the field and thus could loosely be considered an elite group based on their research interests and participation in health informatics research in particular.

Table 2a: Journal Authors	
Count	**Number of journals**
22	Author of one journal
12	Author of two journals
9	Author of three journals
5	Author of four journals
2	Author of five journals
2	Author of six journals
3	Author of seven journals
55	Author Total

Table 2b: Journal Reviewers	
Count	**Number of journals**
9	Reviewer of one journal
9	Reviewer of two journals
3	Reviewer of three journals
2	Reviewer of four journals
1	Reviewer of five journals
3	Reviewer of six journals
0	Reviewer of seven journals
1	Reviewer of eight journals
28	Reviewer Total

Table 2c: Journal Editors	
Count	**Number of journals**
9	Editor of one journal
4	Editor of two journals
2	Editor of three journals
1	Editor of four journals
16	Editor Total

Journals

A summary of the responses for each journal appears in Tables 3, 4, and 5. Table 3 rank orders the journal by the number of respondents who indicated familiarity (highest to lowest). Table 4 provides a ranking of the journal based on the mean (highest to lowest). Table 5 rank orders the journals by median and then by mode (for equal medians). We used familiarity as a means to assess awareness, mean ratings as a means to facilitate the ranking of general content quality of journals, and median and mode as a means of grouping the journals into tiers. We also provide impact factors (IF), where available, as a comparative assessment in each table.

Respondents were instructed not only to rate the journals they were familiar with, but also to indicate what journals they were not familiar with. No respondents indicated awareness of all journals. In fact, of the forty-four journals listed, the average number of respondents rating each journal was 23.77. To assess awareness, we looked at journals identified with a selection other than "0 = Unfamiliar with HIS articles in this journal (or conference)." The Journal of the American Medical Informatics Association (JAMIA) received the highest number of respondents who reported awareness, eighty-two. The following twelve journals showed the strongest indications of recognition among our respondents; at least 25 percent of our respondents indicated awareness of the twelve journals listed.

1. *Journal of the American Medical Informatics Association*
2. *International Journal of Medical Informatics*
3. *Artificial Intelligence in Medicine*
4. *Methods of Information in Medicine*
5. *BMC Medical Informatics and Decision Making*
6. *Journal of the American Health Information Management Association*
7. *Journal of Biomedical Informatics*
8. *MD Computing*
9. *International Journal of Healthcare Technology Management*
10. *IEEE Engineering in Medicine and Biology*
11. *IEEE Transactions on Information Technology in Biomedicine*
12. *Journal of Telemedicine and Telecare*

Table 3: Health Informatics Journal Rating by Number of Respondents Stating Awareness of Journal (N)								
Health Informatics Journal by N	**N**	**Mean**	**Median**	**Mode**	**IF 2005**	**IF 2006**	**IF 2007**	**IF 2008**
Journal of the American Medical Informatics Association	82	3.62	4	4	4.34	3.98	3.09	3.42
International Journal of Medical Informatics	55	3.18	3	3	1.37	1.73	1.58	2.75
Artificial Intelligence in Medicine	51	2.55	3	3	1.88	1.63	1.82	1.96
Methods of Information in Medicine	43	2.93	3	3	0.97	1.68	1.45	1.06
BMC Medical Informatics and Decision Making	42	2.52	2	2				
Journal of the American Health Information Management Association	39	2.62	3	2				
Journal of Biomedical Informatics	37	3.14	3	4	2.39	2.35	2.00	1.92
MD Computing	36	2.19	2	3				
International Journal of Healthcare Technology and Management	35	2.60	3	3				
IEEE Engineering in Medicine and Biology	34	2.88	3	3	1.23	0.94	1.07	1.47
IEEE Transactions on Information Technology in Biomedicine	32	3.22	3	4	1.38	1.54	1.44	1.94
Journal of Telemedicine and Telecare	32	2.59	3	3	0.75	0.80	0.96	0.89
Medical Decision Making	31	2.84	3	3	1.82	1.74	2.20	2.93
Health Informatics Journal	29	2.45	2	2				
Journal of Medical Internet Research	28	2.64	3	3		2.89	2.95	3.59
Computers, Informatics, Nursing	27	2.37	2	2	0.83	1.04	0.96	0.97
Computer Methods and Programs in Biomedicine	26	2.12	2	2	0.79	0.62	0.89	1.22
Medical Informatics and the Internet in Medicine	24	2.75	3	3	0.42	0.55	0.49	0.92
Telemedicine and e-Health	24	2.63	2	2	0.82	0.82	0.89	1.39
British Journal of Healthcare Computing and Information Management	23	2.74	3	2				
International Journal of Technology Assessment in Health Care	23	2.78	3	3,4	0.72	1.15	1.41	1.44
Journal of Medical Systems	23	2.30	2	2		0.58	0.45	0.67
Health Data Management	22	1.91	2	2				
Informatics in Primary Care	22	2.36	2	2				
International Journal of Electronic Healthcare	21	2.48	2	2				
Computers in Biology and Medicine	19	2.58	3	2	1.36	1.07	1.17	1.27
Studies in Health Technology and Informatics	18	2.50	2	2				
Information Technology and Nursing	17	2.24	2	2				
Health Informatics Online	15	2.33	2	2				
Informatics Review	14	1.93	2	2				
Health Informatics Europe	13	2.15	2	2				
Nursing and Health Informatics Journal	12	2.08	2	2				
Linux Medical News	11	1.73	2	1				
Online Journal of Nursing Informatics	11	2.18	2	1				
BioSystems	10	1.70	2	2	1.14	1.08	1.65	1.48
Journal of Clinical Monitoring and Computing	10	2.10	2	2				
Medical Computing Today	10	2.00	2	3				
Health and Medical Informatics Digest	8	2.38	2	2				
Medical Informatics-London	8	2.25	2	1,3				
Biomedizinische Technik	7	2.00	2	2	0.89	0.83	0.59	0.59
Medical Engineering and Physics	7	1.86	1	1	1.15	1.18	1.47	2.22
Computerized Medical Imaging and Graphics	6	2.33	2	1	1.09	0.91	0.85	1.19
Medical and Biological Engineering and Computing	6	2.50	2	2	1.03	1.02	0.94	1.38
Automedica Journal	5	1.40	1	1				

Table 4: Health informatics Journal Rating by Mean								
Health Informatics Journal	**N**	**Mean**	**Median**	**Mode**	**IF 2005**	**IF 2006**	**IF 2007**	**IF 2008**
Journal of the American Medical Informatics Association	82	3.62	4	4	4.34	3.98	3.09	3.42
IEEE Transactions on Information Technology in Biomedicine	32	3.22	3	4	1.38	1.54	1.44	1.94
International Journal of Medical Informatics	55	3.18	3	3	1.37	1.73	1.58	2.75
Journal of Biomedical Informatics	37	3.14	3	4	2.39	2.35	2.00	1.92
Methods of Information in Medicine	43	2.93	3	3	0.97	1.68	1.45	1.06
IEEE Engineering in Medicine and Biology	34	2.88	3	3	1.23	0.94	1.07	1.47
Medical Decision Making	31	2.84	3	3	1.82	1.74	2.20	2.93
International Journal of Technology Assessment in Health care	23	2.78	3	3,4	0.72	1.15	1.41	1.44
Medical Informatics and the Internet in Medicine	24	2.75	3	3	0.42	0.55	0.49	0.92
British Journal of Healthcare Computing and Information Management	23	2.74	3	2				
Journal of Medical Internet Research	28	2.64	3	3	---	2.89	2.95	3.59
Telemedicine and e-Health	24	2.63	2	2	0.82	0.82	0.89	1.39
Journal of the American Health Information Management Association	39	2.62	3	2				
International Journal of Healthcare Technology and Management	35	2.60	3	3				
Journal of Telemedicine and Telecare	32	2.59	3	3	0.75	0.80	0.96	0.89
Computers in Biology and Medicine	19	2.58	3	2	1.36	1.07	1.17	1.27
Artificial Intelligence in Medicine	51	2.55	3	3	1.88	1.63	1.82	1.96
BMC Medical Informatics and Decision Making	42	2.52	2	2				
Studies in Health Technology and Informatics	18	2.50	2	2				
Medical and Biological Engineering and Computing	6	2.50	2	2	1.03	1.02	0.94	1.38
International Journal of Electronic Healthcare	21	2.48	2	2				
Health Informatics Journal	29	2.45	2	2				
Health and Medical Informatics Digest	8	2.38	2	2				
Computers, Informatics, Nursing	27	2.37	2	2	0.83	1.04	0.96	0.97
Informatics in Primary Care	22	2.36	2	2				
Health Informatics Online	15	2.33	2	2				
Computerized Medical Imaging and Graphics	6	2.33	2	1	1.09	0.91	0.85	1.19
Journal of Medical Systems	23	2.30	2	2		0.58	0.45	0.67
Medical Informatics-London	8	2.25	2	1,3				
Information Technology and Nursing	17	2.24	2	2				
MD Computing	36	2.19	2	3				
Online Journal of Nursing Informatics	11	2.18	2	1				
Health Informatics Europe	13	2.15	2	2				
Computer Methods and Programs in Biomedicine	26	2.12	2	2	0.79	0.62	0.89	1.22
Journal of Clinical Monitoring and Computing	10	2.10	2	2				
Nursing and Health Informatics Journal	12	2.08	2	2				
Medical Computing Today	10	2.00	2	3				
Biomedizinische Technik	7	2.00	2	2	0.89	0.83	0.59	0.59
Informatics Review	14	1.93	2	2				
Health Data Management	22	1.91	2	2				
Medical Engineering and Physics	7	1.86	1	1	1.15	1.18	1.47	2.22
Linux Medical News	11	1.73	2	1				
BioSystems	10	1.70	2	2	1.14	1.08	1.65	1.48
Automedica Journal	5	1.40	1	1				

Table 5: Journal Rankings by Median then Mode								
Health Informatics Journal by Median and Mode	**N**	**Mean**	**Median**	**Mode**	**IF 2005**	**IF 2006**	**IF 2007**	**IF 2008**
Journal of the American Medical Informatics Association	82	3.62	4	4	4.34	3.98	3.09	3.43
International Journal of Technology Assessment in Heath Care	23	2.78	3	3,4	0.72	1.15	1.41	1.44
IEEE Transactions on Information Technology in Biomedicine	32	3.22	3	4	1.38	1.54	1.44	1.94
Journal of Biomedical Informatics	37	3.14	3	4	2.39	2.35	2.00	1.92
International Journal of Medical Informatics	55	3.18	3	3	1.37	1.73	1.58	2.75
Methods of Information in Medicine	43	2.93	3	3	0.97	1.68	1.45	1.06
IEEE Engineering in Medicine and Biology	34	2.88	3	3	1.23	0.94	1.07	1.47
Medical Decision Making	31	2.84	3	3	1.82	1.74	2.20	2.93
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Journal of Medical Internet Research	28	2.64	3	3		2.89	2.95	3.59
Journal of Telemedicine and Telecare	32	2.59	3	3	0.75	0.80	0.96	0.89
International Journal of Healthcare Technology and Management	35	2.60	3	3				
Artificial Intelligence in Medicine	51	2.55	3	3	1.88	1.63	1.82	1.96
British Journal of Healthcare Computing and Information Management	23	2.74	3	2				
Journal of the American Health Information Management Association	39	2.61	3	2				
Computers in Biology and Medicine	19	2.58	3	2	1.36	1.07	1.17	1.27
Medical Informatics-London	8	2.25	2	1,3				
MD Computing	36	2.19	2	3				
Medical Computing Today	10	2.00	2	3				
Telemedicine and e-Health	24	2.62	2	2	0.82	0.82	0.89	1.39
BMC Medical Informatics and Decision Making	42	2.52	2	2				
Studies in Health Technology and Informatics	18	2.50	2	2				
Medical and Biological Engineering and Computing	6	2.50	2	2	1.03	1.02	0.94	1.38
International Journal of Electronic Healthcare	21	2.48	2	2				
Health Informatics Journal	29	2.45	2	2				
Health and Medical Informatics Digest	8	2.38	2	2				
Computers, Informatics, Nursing	27	2.37	2	2	0.83	1.04	0.96	0.97
Informatics in Primary Care	22	2.36	2	2				
Health Informatics Online	15	2.33	2	2				
Journal of Medical Systems	23	2.30	2	2		0.58	0.45	0.67
Information Technology and Nursing	17	2.24	2	2				
Health Informatics Europe	13	2.15	2	2				
Computer Methods and Programs in Biomedicine	26	2.12	2	2	0.79	0.62	0.89	1.22
Journal of Clinical Monitoring and Computing	10	2.10	2	2				
Nursing and Health Informatics Journal	12	2.08	2	2				
Biomedizinische Technik	7	2.00	2	2	0.89	0.83	0.59	0.59
Informatics Review	14	1.93	2	2				
Health Data Management	22	1.91	2	2				
Biosystems	10	1.70	2	2	1.14	1.08	1.65	1.48
Computerized Medical Imaging and Graphics	6	2.33	2	1	1.09	0.91	0.85	1.19
Online Journal of Nursing Informatics	11	2.18	2	1				
Linux Medical News	11	1.73	2	1				
Medical Engineering and Physics	7	1.86	1	1	1.15	1.18	1.47	2.22
Automedica Journal	5	1.40	1	1				

In assessing the quality rankings according to the mean, median, and mode scores, we used a cut-off score of 3, given that anchor point "3" was described as "significant as an outlet for publication." Using the mean score for assessment, four journals were assessed as minimally significant as an outlet for publication: (1) *Journal of the American Medical Informatics Association,* (2) *IEEE Transactions on Information Technology in Biomedicine,* and (3) *International Journal of Medical Informatics,* and (4) *Journal of Biomedical Informatics.* To assess whether these could be considered "top-tier journals" based on the mean rankings, we performed an ANOVA test between two groups: the first four journals (by mean score) and the remaining journals. The first group was statistically distinct ($p < 0.05$; $f = 19.161$) from the remaining set of journals and could be considered "top-tier" journals based on respondents' mean scores. To determine whether further tiered distinction existed, we performed post-hoc testing. Specifically, we defined three groups based on means (group 1 = 1.00 to 1.99, group 2 = 2.00 to 2,99, group 3 = 3.00 to 3,99) and performed Shaffe testing. All three groups were statistically distinct, supporting the potential existence of multiple tiers.

Although the mean score provides a good indication of quality relative to all other journals and may be used to identify significant groupings, the median and mode could also be used for delineating groups of journals. Overall, four publications were set apart as "outstanding as an outlet for publication" (score of 4 in either median or mode) when grouped by median and mode: (1) *Journal of the American Medical Informatics Association,* (2) *International Journal of Technology Assessment in Heath Care,* (3) *IEEE Transactions on Information Technology in Biomedicine,* and (4) *Journal of Biomedical Informatics.* In using our significant cut-off (score at least 3 in median), twelve other journals may be added to the list:

1. *International Journal of Medical Informatics*
2. *Methods of Information in Medicine*
3. *IEEE Engineering in Medicine and Biology*
4. *Medical Decision Making*
5. *Medical Informatics and the Internet in Medicine*
6. *Journal of Medical Internet Research*
7. *Journal of Telemedicine and Telecare*
8. *International Journal of Healthcare Technology Management*
9. *Artificial Intelligence in Medicine*
10. *British Journal of Healthcare Computing and Information Management*
11. *Journal of the American Health Information Management Association*
12. *Computers in Biology and Medicine*

Applying labels to journal groupings, such as "A-level journals," "B-level journals," and so on, can be arbitrary. For example, the top four journals in this study were considered "outstanding as an outlet for publication" and may be labeled "A-level journals"; some researchers may consider these "A+ journals." In addition, there are various rankings that depend on the method of ranking used (awareness, mean, median/mode). Because of the subjectivity involved, the process of applying labels to the groups is left to the reader.

To facilitate completeness of the list, respondents were allowed to add journals. In addition to the choices provided, respondents suggested seven other journals that were of value to the health informatics field. The write-in journals (and the number of people that wrote in the journal) are indicated in Table 6. The write-in rankings for the Journal of Healthcare information System showed a mean of 3, a mode of 3, and a median of 3. We did not want to skew results with the write-ins, but the write-in results suggests that at minimum the International Journal of Healthcare Technology Management should be included in consideration as a significant publication outlet.

Table 6: Write-in Health informatics Journal Ratings by Mean (Ordered by Number of Votes, Then Alphabetic)

Journal	Write in #	Importance (Max. 4)
International Journal of Healthcare information System	3	3
Computers and Biomedical Research	1	3
Perspectives in Health Information Management	1	3
Biomedical Digital Libraries	1	2
Journal of Healthcare Information Management	1	3
The Lancet	1	2
Topics in Health Information Management	1	3

Conferences

The listing of conferences by mean is shown in Table 7. The top-rated conference, the American Medical Informatics Association Symposium, is rated significantly higher ($p < 0.05$) than the other conferences in the list. It is also ranked number one by median and by mode.

Table 7: Conference Ratings by Mean

Conference	N	Mean	Median	Mode
American Medical Informatics Association Symposium	80	3.66	4	4
International Medical Informatics Association (IMI)	66	3.52	4	4
Hawaii International Conference on System Sciences (Health Care Track)	61	2.98	3	3
Americas Conference on Information Systems (AMCIS)	37	2.89	3	3
American Telemedicine Association Conference (ATA)	25	2.88	3	3
HEALTH-e	12	2.83	3	3,4

In addition to the choices provided, respondents suggested twenty-seven other conferences that were of value to the health informatics field. Table 8 provides a list of the conference write-ins, the number of respondents adding the conference, and the importance rating (mean for those with more than one rating).Twenty-four subjects indicated only one additional conference. Two subjects indicated two additional conferences. Four subjects indicated three additional conferences.

Table 8: Write- in Health informatics Conference Ratings by Mean (Ordered by Number of Votes, Then by Importance)

Conference	# Write ins	Importance (Max. 4)
Healthcare Information and Management System Society HIMSS	5	3.6
Medical Informatics in Europe (MIE)	3	2.6
ACM	2	4
Health Informatics New Zealand	2	4
Health Informatics Conference Australia (HIC)	2	3
MEDINFO	2	3.5
International Conference on Information Systems (ICIS)	2	3.5
Academy of Management (Health Research track)	2	3
ECIS	2	3
American Health Information Management Association (AHIMA)	1	4
American Society for Information Science & Technology	1	4
European Federation of Medical Informatics (EFMI)	1	4
HCTM conference	1	4
Healthcom	1	4
Hospital of the Future	1	4
IEEE—Engineering in Medicine and Biology Society	1	4
IEEE—Symposium on Computer Based Medical Systems	1	4
International Symposium of Health Information Management	1	4
IT in Healthcare: Socio-technical Approaches	1	4
Pacific Symposium on Biocomputing	1	4
Association of Computational Linguistics (ACL)	1	3
Australian IS Conference	1	3
e-Health (Canadian conference)	1	3
IASTED conference on Telehealth	1	3
Mednet (World Congress on Internet in Medicine)	1	3
Usability Professionals Association (UPA)	1	3

IV. DISCUSSION

Journals

The number of journals and general level of the journal quality ratings suggest that health informatics is emerging as a separate and distinct field of study with viable specialized publication outlets. The four top-rated journals using the mean assessment are the *Journal of the American Medical Informatics Association, IEEE Transactions on Information Technology in Biomedicine, International Journal of Medical Informatics,* and *Journal of Biomedical Informatics.*

Classification by mode includes these four and also adds several journals to the list of top journals rated as significant publication outlets. Generally, those journals that are well known are also highly ranked. For example, the *Journal of the American Medical Informatics Association* and the *International Journal of Medical Informatics,* two of the top journals, were also rated more often than any other publication.

The risk of using impact factors alone to determine potential sources of published studies in an emerging domain and publication outlets is evidenced by Tables 2, 3, and 4, as many of the journals rated as appropriate publication outlets on the list do not yet have IF's.

In addition to rating the forty-four specified journals, respondents suggested seven journals as additions to the list. Based on these results, it seems that the *International Journal of Healthcare Information Systems* should be considered a viable outlet. It is also interesting to note that most of the journals receiving write-in votes seemed to be dedicated to health informatics topics, which supports the earlier suggestion that health informatics is continuing to define itself as a separate discipline.

An analysis of the "birth year" of each journal, as listed in the right-hand column in Table 9, provides some interesting observations. First, of the top ten journals using mean assessment, six are less than twenty years old. In fact, four of the health informatics journals in the top-ten list according to the mean are less than twenty years old. This, of course, is intuitively obvious due to the relatively young age of health informatics as a separate field of study.

Considering the suggested additions, it appears that there are at least forty-five appropriate reference journals for prior work and potential publishing outlets specified as related to health informatics research. However, many of these journals were identified as being familiar by only a small group of our respondents. This finding could indicate that the group of HIS journals is not a homogeneous pool and that researchers have already identified the subset of journals that address their interests. Possible research community sub-domains may be based on technologies addressed (e.g., web-based or telehealth technologies), on their focus on a particular field of medicine (e.g., nursing), on types of articles published (e.g., clinical trials or qualitative studies), or on degree of technical content. Consequently, having a paper accepted for publication is not as simple as submitting a health informatics paper to any one of these journals. Rather, authors need an understanding of the requirements for these journals based on the research communities in which they exist. For instance, publishing in the International Journal of Medical Informatics (which emphasizes the evaluation of systems in healthcare settings) is very different than publishing in *IEEE Transactions on Information Technology in Biomedicine* (which publishes basic and applied papers on information technology applications).

Table 9: Top 10 Journal Rating by Mean Noting Starting Year

Top 10 Journal Ratings by Mean	Mean	Starting	Less than 20 years
Journal of the American Medical Informatics Association	3.62	1994	YES
IEEE Transactions on Information Technology in Biomedicine	3.22	1997	YES
International Journal of Medical Informatics **	3.18	1997	YES
Journal of Biomedical Informatics *	3.14	1968	NO
Methods of Information in Medicine	2.93	1962	NO
IEEE Engineering in Medicine and Biology	2.88	1988	NO
Medical Decision Making	2.84	1981	NO
International Journal of Technology Assessment in Health Care	2.78	1985	NO
Medical Informatics and the Internet in Medicine	2.75	1976,1991-online	NO
British Journal of Healthcare Computing Information Management	2.74	1993	YES

However, it can be discouraging to assume that broad awareness of appropriate journal outlets for a particular research community in HIS research does not exist, because it implies that important related work may be overlooked in research design, theory building, and data analysis in research studies in this domain. Furthermore, with the abundance of journals available, it is important that health informatics researchers be made aware of the various publishing opportunities. The high number of people unfamiliar with many of the journals should send a message to their editors to "get the word out" about their journals.

Conferences

Much like the journal ratings, the list of conferences implies that health informatics is emerging as a separate discipline. A number of these conferences, including the top conference, the American Medical Informatics Association Symposium, address topics in health informatics exclusively.

It is evident from the number of write-ins, twenty-seven, that our original list should be expanded for future studies. At a minimum, the conferences of the Healthcare Information and Management System Society (HIMSS) and the Medical Informatics in Europe (MIE), which received five and three write-in votes, respectively, should be considered in assessing conference outlets for health technology research. In addition, the range of themes of write-in conferences goes well beyond those dedicated to health IT (e.g., Usability Professional Association). This suggests that the topic of health IT is making its way into a variety of conference themes. Furthermore, the write-ins suggest increasing connections between research and practitioner forums. For example, the HIMSS conference, which historically focused primarily on practitioner presentation, now includes a research track.

Limitations and Future Work

Our findings should be interpreted with some caution by those particularly focused on an HIS sub-domain; a one-to-one linkage between awareness and importance does not always exist, especially because these journals are not necessarily trans-disciplinary. For example, *JAMIA* may be the most important journal in the medical informatics community, but another journal may be the most important journal for the technically focused HIS research community. Future studies should delve deeper into classifications and perspectives of potential HIS sub-domain research communities.

Regarding additional ways to classify journals, future studies could ask respondents to indicate whether they would classify a journal as intended more for a practitioner or an academic audience or somewhere in between. We make this recommendation with some caveats. We would also encourage prospective authors to use this information only as an indication; it will still be important for authors to review the scope of interest, instructions to authors, and articles a journal has published previously to insure their manuscript will fall within the scope of interest of the journal and use a style to reach the journal's audience. It is also important to note that target audiences may change over time.

Although the response rate for this study was not as high as we had hoped, studies that have used a group of researchers to observe the quality of journals and conferences have made valuable contributions to the emergence of the IS discipline in its early years, typically before the discipline was well defined [Peffers and Tang, 2003]. That said, as affiliations, networks in the field, and academic departments in this area merge and converge, we would encourage future research that capitalizes on expanding the sample by use of emerging structures, such as list serves, special interest groups, and virtual conference postings, to encourage participation in a replication of this survey. We also suggest that write-in journals and conferences be included in a future project. In addition, we acknowledge the need for future replication studies as journals evolve. Thus, an assessment of rankings should be a recurring effort to update lists to reflect the progress and maturity of the journals as well as to include additional journals.

V. CONCLUSION

This study was undertaken as the first effort of its kind to determine the perceptions of health informatics domain researchers regarding the quality of journals and conferences as publication outlets. Respondents were asked to rate journals regarding their appropriateness for health informatics publication and to rate conferences based on their value to the health informatics field. Overall, results indicate that health informatics is an emerging, distinct field with many existing specialized publication outlets. However, awareness of these journals is limited, even among those in the field (no respondent reported awareness of all journals, and respondents were generally aware of only about half of the forty-five journals listed). Given this evidence of lack of awareness, this study provides a needed reference and introduction to researchers interested in this type of research, particularly those in tangential disciplines, such as information systems with their own domain journals. Awareness is needed to consider this body of work in performing literature reviews to build on past work and shape studies and data analysis. Awareness is also important to those who are seeking outlets for research efforts involving health technologies.

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