

Improving Bridging from Informatics Theory to Practice

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Summary

Background: In 1962, Methods of Information in Medicine (MIM) began to publish papers on the methodology and scientific fundamentals of managing data, information, and knowledge in biomedicine and health care. Meeting an increasing demand for research about practical implementation of health information systems, the journal Applied Clinical Informatics (ACI) was launched in 2009. Both journals are official journals of the International Medical Informatics Association (IMIA).

Objectives: Based on prior analyses, we aimed to describe major topics published in MIM during 2014 and to explore whether theory of MIM influenced practice of ACI. Our objectives were further to describe lessons learned and to discuss possible editorial policies to improve bridging from theory to practice.

Methods: We conducted a retrospective, observational study reviewing MIM articles published during 2014 (N=61) and analyzing reference lists of ACI articles from 2014 (N=70). Lessons learned and opinions about MIM editorial policies were developed in consensus by the two authors. These have been influenced by discussions with the journal's associate editors and editorial board members.

Results: The publication topics of MIM in 2014 were broad, covering biomedical and health informatics, medical biometry and epidemiology. Important topics discussed were biosignal interpretation, boosting methodologies, citation analysis, health-enabling and ambient assistive technologies, health record banking, safety, and standards. Nine ACI practice articles from 2014 cited eighteen MIM theory papers from any year. These nine ACI articles covered mainly the areas of clinical documentation and medication-related decision support. The methodological basis they cited from was almost exclusively related to evaluation. We could show some direct links where theory impacted practice. These links are however few in relation to the total amount of papers published.

Conclusions: Editorial policies such as publishing systematic methodological reviews and clarification of possible practical impact of theory-focused articles may improve bridging.

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1. Introduction

In 1962, Methods of Information in Medicine (MIM) began to publish papers on the methodology and scientific fundamentals of organizing, representing, and analyzing data, information, and knowledge in biomedicine and health care [1, 2]. As a result of perceiving an increasing demand for research and information focusing on the implementation and management of health information systems, 47 years later the journal Applied Clinical Informatics (ACI) was launched in 2009 [3-5]. Both journals are official journals of IMIA, the International Medical Informatics Association [6]. Published by the same publisher [7] they can be viewed to some extent as companion journals intended to maintain and strengthen bridging from informatics theory to practice and vice versa on an international level [8, 9].

The scope of MIM includes, as mentioned, methodology and scientific fundamentals, and is focused on theory. As biomedicine and health care are the journal's application areas, it is expected that at least in the long term, theory will have an impact on the quality and efficiency of health care, and so on practice [10]. This should in particular be reflected in publications of ACI ('practice') and MIM ('theory'). In the last year congruencies and interdependencies in publications of ACI and MIM had therefore been explored [11, 12]. We recognized that congruencies could be found in themes, but with different focus in its contents. Interdependencies from practice to theory as well as from theory to practice were, however, only limited. We finally had to acknowledge that the bridging goals remained far from being achieved and will require additional efforts. Further there will be a need to continue these analyses, probably with consequences for the journals' editorial policies. In this manuscript as well as in a corresponding paper [13], we want to continue to explore this matter and to find ways to improve bridging; here specifically bridging from theory to practice by analyzing MIM contents and ACI references.

2. Questions

The following questions were raised:

1. Which major topics were being discussed in recent MIM publications?
2. Have there been links so that theory of MIM has influenced practice of ACI?
3. Are there lessons learned in the context of bridging informatics theory and practise?
4. How could MIM editorial policies evolve to foster and improve bridging?

Our results for and/or answers to questions 1 to 4 can be found in sections 4 to 7.

3. Material and Methods

For question 1 we chose, similar to last year, a retrospective, prolective, observational study design. In order to continue the respective last year analyses of 2012 and 2013 we now searched all publications, which appeared in the year 2014 in MIM (volume 53). Publications were defined as journal articles excluding editorials and letters to the editor. To identify these publications we used Medline/PubMed [14], specifying MIM as journal and as time limits January 1, 2014, until December 31, 2014. The Medline/PubMed search was done on October 2, 2015. From the reference list obtained (N=101), we first excluded all electronic articles to be printed later than 2014 (Epub ahead of print). From the remaining list of 72 articles, which appeared in 2014, we excluded the editorials (N=8) and the letters to the editor (N=3) of 2014 so that finally 61 publications remained for the analysis. These publications were indexed. Complying with rules for good scientific practice (e.g. [15]), all indexing data have been stored. Copies of the files can be requested from the authors. All analysed publications can be accessed through the respective publishing company's web site mentioned above.

For question 2 we analysed the reference lists of all ACI articles published during 2014 except one editorial [16] and two special articles [11, 17] (N=70) and searched for references to articles published in MIM in any year. This was done using the find function across the reference lists of each

ACI article on the ACI journal website [3] with the search terms “Methods Inf Med” and “Methods of Information in Medicine”.

Answers for questions 3 and 4 are based on the authors' opinion and have to remain subjective.

4. Major Topics Discussed in MIM

As a journal that emphasizes the methodology and scientific fundamentals of organizing, representing, and analyzing data, information, and knowledge in biomedicine and health care, the publication topics of MIM in 2014 were again and as expected quite broad and beyond the scope of 'just' biomedical and health informatics. The following list of publications is not complete, but highlights, at least from our point of view, the major themes from various perspectives including important (but not all) references.

Four focus themes had been discussed in 2014. The one on health record banking discussed specific approaches for a 'traditional' informatics topic: on patient-centered (not: health care institution-centered) care [18-20]. In the context of health-enabling and ambient assistive technologies, two different focus themes appeared. Both showed that research in this field is coming closer to the practice of health care. One focus theme discussed the use of data from ambient assisted living and smart homes in electronic health records [21-23], the second one on how pervasive health research evolved into clinical practice [24-26]. Another focus theme centered on biosignal interpretation. From a first point of view this appeared to be another instance of publications in one of the more traditional themes of MIM. Exploring content of research however more in depth, one can however see new application fields and considerable overlap to research in health-enabling and ambient assistive technologies, e.g., when new approaches are discussed on assessing depressive states [27], on detecting sleep apnea [28], and on the use of bed sensors for heart rate monitoring [29].

Two papers on boosting methodologies were assigned in 2014 as so-called for-discussion-papers, in order to stimulate discussion, including controversial debates on this interdisciplinary topic [30-32].

In 2014 medication safety was discussed in two papers [33, 34]. Research results on further 'safety aspects' were presented on authentication in clinical documentation [35] and on medical device life-cycles [36]. Manuscripts on standards formed again a considerable part of the publications of last year. They included articles on standards for ontologies [37], for data and observations [38] and for health-enabling technologies [20]. Publications on citation analysis and on its relevance for health care were also presented and discussed [39, 40].

As before, in 2014 modelling aspects (e.g. [41, 42]) as well as aspects on methodological approaches (e.g. [43, 44]) for the analysis of data, information, and knowledge were also raised in most of the papers. And again the methodological roots came from informatics (e.g. [45, 46]) as well as from biostatistics (e.g. [47, 48]) and sometimes from both sides (e.g. [49, 50]).

5. Links from Theory to Practise

In 2014 Haux and Lehmann stated that bridging between both journals (MIM and ACI) was very limited although congruencies in themes could be found but with different focus [11, 12]. These statements were the results of analysing MIM and ACI articles published during 2012–2013 by comparing articles from essentially the same time periods. With MIM having a cited half life of 7.4 years in 2014 [51], it would be rather unusual to find links when comparing articles of the same year. In addition to the topic descriptions of MIM, we therefore looked for links from MIM theory to ACI practice by analysing the reference lists of ACI publications from 2014.

Analysis of the references of each ACI publication published during 2014 except [11, 16, 17] (N=70) revealed nine ACI articles [52-60] citing eighteen articles from MIM [61-78]. Four of the cited MIM articles were published between 1991 and 1999, six were published between 2000 and 2009 and eight were published between 2010 and 2013. The nine ACI articles that were influenced by theory published in MIM dealt with electronic health records [52, 56], clinical documentation [53, 58, 59], SNOMED CT [57], medication-related decision support [54, 60] and user acceptance of

computerized medication lists [55]. Most of the referenced MIM publications were related to the topic of evaluation. Two articles described different evaluation approaches [61, 63], one article reported new trends in evaluation research [62], and several others consisted of different kinds of evaluation studies. One article pointed to mapping guidelines to support concept selection in SNOMED CT [75]. Two articles were systematic reviews [67, 72]. Other MIM articles were used for background descriptions in the respective ACI publications.

We did not systematically analyze the reference lists of all ACI articles but only looked at cited MIM articles. From Journal Citation Reports® for 2014 [51], we could however see that most references in ACI cite articles from JAMIA, MIM, NEJM, JAMA and IJMI (in descending order).

6. Discussion

By including citation analysis of ACI publications we could find more direct links in this year's analysis than in last year's. 13% of ACI publications in 2014 cited a MIM paper. The topics for which referencing mainly took place, clinical documentation and medication-based decision support, were also prominent topics revealed in last year's analysis of ACI. We could however also see that the methodological basis from which ACI cited was almost exclusively related to evaluation. With a relatively low number of papers per year (72 for MIM and 73 for ACI), a single publication may have had a large impact on our results and we remain aware of the limitations, which are mainly that longer terms and a broader spectrum of publications may lead to further results [79] as well as a more topic-specific analysis. It would therefore be interesting to perform both, more long-term comparative studies and to also include other journals of our subject area. The majority of MIM publications and also one third of the ACI publications citing MIM articles were written by European authors. On the other hand, we noted that many ACI articles cited publications in other US-based journals such as JAMIA and authors often cited methodological reviews when referencing theoretical work.

The lessons learned from this exploratory exercise show that we can see some direct links evolving where theory impacted practice. These links are however few in relation to the total amount of papers published. Reasons for this have to be analyzed further. Possible reasons might be that practical implications are not always clear, that studies can not be replicated because the underlying data is not always openly accessible, or that the nature of the topics discussed in theory and practice simply do not match. Also both journals aim to be truly international. However, MIM authors have mainly European affiliations, ACI authors are mainly affiliated with North American institutions (despite a double blind review process in ACI).

7. Conclusions

We are still convinced that both types of publications, on theory and on practice, are needed, and that bridging, which eventually can be supported by editorial policies, is of high importance for both, progress in science and in practice. MIM has traditionally focused on publishing methods from biomedical and health informatics, epidemiology and biometry and we are aware of the much broader scope of MIM compared to ACI, where only a minor part of MIM publications supported ACI practice. How could then MIM editorial policies evolve to foster and improve bridging? Editorial policies are essentially shaped by the core editorial team (editor-in-chief, senior and associate editors) and influenced by international editorial board members and student editorial board members. To review the journal's focus and scope and to work towards an international author- and readership and attract submissions of highest quality is essential. Further measures to be considered may include but are not limited to systematic methodological reviews, clarification of possible practical implications of theoretical work, or specific focus themes on topics discussing both theoretical gaps and practical applications of methods and theories.

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Conflicts of Interest

The authors are the current and incoming editors of *Methods of Information in Medicine*. They are editorial board members of *Applied Clinical Informatics*. There are no other conflicts to declare.

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