

From Bed to Bench: Bridging from Informatics Practice to Theory

An Exploratory Analysis

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Keywords

Biomedical informatics, health informatics, clinical informatics, medical informatics, serial publications

Summary

Background: In 2009, Applied Clinical Informatics (ACI) – focused on applications in clinical informatics – was launched as a companion journal to Methods of Information in Medicine (MIM). Both journals are official journals of the International Medical Informatics Association.

Objectives: To explore which congruencies and interdependencies exist in publications from theory to practice and from practice to theory and to determine existing gaps. Major topics discussed in ACI and MIM were analyzed. We explored if the intention of publishing companion journals to provide an information bridge from informatics theory to informatics practice and vice versa could be supported by this model. In this manuscript we will report on congruencies and interdependences from practice to theory and on major topics in MIM.

Methods: Retrospective, prolective observational study on recent publications of ACI and MIM. All publications of the years 2012 and 2013 were indexed and analyzed.

Results: Hundred and ninety-six publications were analyzed (ACI 87, MIM 109). In MIM publications, modelling aspects as well as methodological and evaluation approaches for the analysis of data, information, and knowledge in biomedicine and health care were frequently raised – and often discussed from an interdisciplinary point of view. Important themes were ambient-assisted living, anatomic spatial relations, biomedical informatics as scientific discipline, boosting, coding, computerized physician order entry, data analysis, grid and cloud computing, health care systems and services, health-enabling technologies, health information search, health information systems, imaging, knowledge-based decision support, patient records, signal analysis, and web science. Congruencies between journals could be found in themes, but with a different focus on content. Interdependencies from practice to theory, found in these publications, were only limited.

Conclusions: Bridging from informatics theory to practice and vice versa remains a major component of successful research and practice as well as a major challenge.

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1. Introduction

In 2008, a call for an applied clinical informatics journal was published in *Methods of Information in Medicine* (MIM) [1] as a result of an increasing demand for research and information focusing on the implementation and maintenance of bedside health information systems that had been perceived. Subsequently, in late 2009, *Applied Clinical Informatics* (ACI) started to publish papers in the core domains of clinical information systems, administrative and management systems, eHealth systems, information technology development, deployment, and evaluation, socio-technical aspects of information technology (IT) and health IT training [2, 3].

Five years after the launch of ACI, an opportunity to explore the relationship of the content of MIM and ACI was grasped, to investigate if informatics theory and methods (as reflected in MIM) were developing in parallel to the application of the science (as reflected in ACI) and to explore which congruencies and which interdependencies exist.

2. Questions

The following research questions were raised:

Which congruencies and which interdependencies exist

- (tp) from theory to practice?
 - (I.e., in this context, from content reported in MIM to content published in ACI.)
- (pt) from practice to theory?
 - (I.e., in this context, from content reported in ACI to content published in MIM.)
 - And what are existing gaps?

To answer these questions, we first needed to know

- Which major topics were being discussed
 - (a) in ACI?
 - (m) in MIM?

The final question was:

- (b) Can the intent to bridge knowledge from informatics practice to informatics theory be supported by this model of companion journals?

The study design for our investigation is presented in the next section. Answers to questions (m) and (pt) will be presented in this paper in sections 4.1 and 4.2 (as being of major interest to the readership of this journal), those for questions (a) and (tp) are presented in MIM (4). Reflections on question (b) will be discussed in both papers in section 4.3. To increase the ease of reading, we have almost identical sections 1–3 and sections 5 and 6 in both papers, being aware that this will generate some redundancy.

3. Material and Methods

We conducted a retrospective, but prospective observational study (cf. [5] on the differences of pro-retrospective and -lective).

As empirical basis for the intended analysis, the authors decided to evaluate publications which appeared in the years 2012 and 2013 in ACI (ACI volumes 3 in 2012 and 4 in 2013, journal information at [6]) and in MIM (MIM volumes 51 in 2012 and 52 in 2013, journal information at [7]). Both journals are official journals of IMIA, the International Medical Informatics Association [8] and both are published by the same publisher, Schattauer Verlag, Stuttgart, Germany [9].

Publications were defined as journal articles excluding editorials and letters to the editor. To identify these publications we used Medline/PubMed [10], specifying as time limits January 1, 2012, until December 31, 2013, and as journals ACI and MIM. The Medline/PubMed search was done on September 21, 2014. From the reference list obtained, we excluded all editorials and all electronic

publications to be printed later than 2013. The number of publications in the respective years is presented in ►Table 1.

To analyze these publications with respect to the research questions raised in section 2, all relevant publications were indexed. Complying with rules for good scientific practice (e.g., [11]), all indexing data and observations, recorded by the authors as basis for this publication, have been stored. Copies of the files can be requested from the authors. All analyzed publications can be accessed through the respective publishing company's web site mentioned above or in case of ACI through PubMedCentral [12].

4. Results

4.1 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 were as expected quite broad and beyond the scope of 'just' biomedical and health informatics in the two years. The following list of publications is not complete, but highlights the major themes from various perspectives including important (but not all) references. Modelling aspects as well as aspects on methodological approaches for the analysis of data, information, and knowledge were raised in most of the papers. These aspects were quite often discussed from an interdisciplinary point of view. For example the methodological roots came from informatics as well as from biostatistics and sometimes from both sides.

As so-called focus themes, seven areas of research were highlighted and discussed: Recent developments in boosting methodology (e.g., [13], [14], [15]), intelligent data analysis for knowledge discovery, patient monitoring, and quality assessment (e.g., [16], [17] [18]), grid and cloud computing in biomedical research ([19], [20], [21], [22]), two topics of medical imaging, one of high performance methods ([23], [24]) and another one on image analysis and modelling (e.g., [25], [26], [27]), health information search, combining text, visual information, and knowledge bases (e.g., [28], [29], [30]), and web science in medicine and health care ([31], [32], [33]). Most of these themes have also been addressed in other publications, outside these focus themes.

For stimulating discussion, including controversial debates, four times in this time period papers were opened up "for discussion", i.e. international experts were invited to comment and an editorial was provided introducing both the paper and the comments. Themes set for discussion were investigations on automatic alerting in computerized physician order entry systems ([34], [35]), biomedical informatics as scientific discipline ([36], [37]), new representations of anatomical spatial relations [38], and new approaches on the joint basis and on relationships of time-frequency techniques in biomedical signal analysis ([39], [40]).

Reflections on biomedical and health informatics as disciplines have a long tradition in MIM. In addition to the one discussion paper this topic was also raised in [41] and [42]. Other, more general and comprehensive reflections could be found on informatics approaches for health care systems and its services (e.g., [43], [44], [45]), on new approaches for patient records (e.g., [46], [47], [48], [49]) and coding systems for diagnoses (e.g., [50]), and on knowledge-based decision support for diagnosis and therapy (e.g., [51], [52], [53]).

Communications on research on health information systems focused on questions of patient-centered (i.e. not institution-centered) architectures and organizational principles (e.g., [54], [55]); often research on ambient-assisted living technologies was presented, including home care as part of patient-centered care (e.g., [56], [57]).

Research in these publications was covering many clinical disciplines. A certain new focus was on psychiatry and mental health, due to new opportunities through health-enabling technologies (e.g., [58], [59]). Last, but not least, questions on appropriate evaluation approaches were discussed (e.g., [60], [61], [62]).

4.2 Congruencies and interdependencies from practice to theory

In analyzing the publications of ACI and MIM in the respective time period and in considering the summaries in sections 4.1 of [4] and of this paper, we can see that some of the contents is overlapping in its themes. Examples are computerized physician order entry systems (e.g., [33] and [63]), knowledge-based decision support (e.g., [51] and [64]), health information systems (e.g., [53] and [65]), ambient-assisted living and telecare (e.g., [55] and [66]). In a more detailed look, we can see that these congruencies are among themes, but with different focus in their contents. ACI is clearly focusing on case studies and investigations in the practice of health care, including implementation, whereas MIM has a focus on communication research results. Interdependencies can be assumed from practice to theory insofar as these practice reports are now communicated through ACI on an appropriate scientific level. A direct impact could, however not be observed.

Limited congruencies could be observed in papers on education and concerning evaluation studies, which are clearly a long-term part of MIM, although some overlaps exist (e.g., [67] for education and [68] for evaluation). Few discussion papers and practically no focus theme papers in MIM overlapped with topics in ACI papers. Insofar here also no interdependencies (at least immediate ones) could be identified, neither from practice to theory nor vice versa.

4.3 Could the intention to support bridging from informatics practice to informatics theory be supported by this model of companion journals?

Based on the results presented in sections 4.1 and 4.2 in the related paper in MIM [4] and in this paper, we have to acknowledge that bridging from practice to theory through the two companion journals is limited. At least significant bridging could not be observed in the comparison of publications in both journals. As the readership of both journals is probably overlapping, we can assume that indirect interdependencies are given.

5. Discussion

The results of this exploratory analysis are twofold. First, there is a clear need for both of these two journals with very different and distinct, but related scope of communicating research results in informatics. Second, we were able to observe some congruencies in journal content, but have to acknowledge that few interdependencies exist. This was even then the case when we excluded publications in MIM focusing on biostatistics and epidemiology (as the scope of MIM – stressing the methodology and scientific fundamentals of organizing, representing, and analyzing data, information, and knowledge in biomedicine and health care extends beyond publications from biomedical and health informatics).

For the editors of these two companion journals this may lead to modifications in their future editorial policy. As bridging from informatics theory to practice and vice versa – informing theory from the bedside – were and are regarded as crucial for progress in informatics practice and theory, additional publication formats that strengthening such bridging as well as targeted related publications that appear simultaneously in both journals may be helpful for future researchers and readers of these journals.

We are aware of several limitations of this exploratory analysis. Adding additional journals in the field may have been more informative and helpful, as well as including a more formal citation analysis. As we wanted to focus after five years of the launch of ACI on the aspects of the two companion journals of ACI and MIM, we finally decided to concentrate on the direct analysis of the contents (as being from our point of view of the highest priority) of the respective papers of these two journals only.

6. Conclusions

Bridging from informatics theory to practice and vice versa, as has been argued in [1]–[3], remains a major component of successful research and practice. Based on the results of our exploratory analysis, we have to acknowledge that these bridging goals remain far from achieved and will require additional efforts.

Conflicts of Interest

The authors are the respective editors of *Methods of Information in Medicine* and *Applied Clinical Informatics*. There are no other conflicts to declare.

Human Subject Protection

The study was performed in compliance with the World Medical Association Declaration of Helsinki on Ethical Principles for Medical Research Involving Human Subjects.

Table 1 Number of publications and issues for ACI and MIM in the years 2012 and 2013.

Number of publications (Number of issues)	Applied Clinical In- formatics	Methods of Information in Medicine	Total
2012	41(4)	58(6)	99
2013	46(4)	51(6)	97
Total	87	109	196

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