Recommendations for Health IT Evaluation Training as a Key Prerequisite to Obtaining Evidence

Elske AMMENWERTH[a,1], Nicolet DE KEIZER[b], Jytte BRENDER McNAIR[c],
Catherine K. CRAVEN[d], Eric EISENSTEIN[e], Andrew GEORGIOU[f], Saif KHAIRAT[g],
Farah MAGRABI[h], Pirkko NYKÄNEN[i], Paula OTERO[j], Michael RIGBY[k],
Philip SCOTT[l], Charlene WEIR[m]

[a] *Institute of Biomedical Informatics, UMIT – University for Health Sciences, Medical Informatics and Technology, Hall in Tirol, Austria*
[b] *Academic Medical Center, University of Amsterdam, Netherlands*
[c] *Department of Health Science & Technology, Aalborg University, Denmark*
[d] *Informatics Institute, University of Missouri, Columbia, USA*
[e] *Duke University, Durham, North Carolina, USA*
[f] *Centre for Health Systems & Safety Research, Australian Institute of Health Innovation, Macquarie University, Sydney, Australia*
[g] *University of North Carolina-Chapel Hill, Chapel Hill, North Carolina, USA*
[h] *Centre for Health Informatics, Australian Institute of Health Innovation, Macquarie University, Sydney, Australia*
[i] *University of Tampere, School of Information Sciences, Tampere, Finland*
[j] *Hospital Italiano de Buenos Aires, Buenos Aires, Argentina*
[k] *Keele University, Keele, Staffordshire, ST5 5BG, U.K.*
[l] *Centre for Healthcare Modelling and Informatics, University of Portsmouth, United Kingdom*
[m] *University of Utah, Salt Lake City, Utah, USA*

Abstract. Systematic health IT evaluation studies are needed to ensure system quality and safety, both to create sound evidence and to ensure its application as part of an evidence-based health informatics approach. Well-trained health informatics specialists are required to guarantee that health IT evaluation studies are conducted in accordance with robust standards. Policy makers and managers need to appreciate how good evidence is obtained by scientific process, and be able to identify where this is the case. This contribution presents recommendations for the structure, scope and content of a university-based health IT evaluation course on the master or postgraduate level. These recommendations are based on a series of international workshops combined with a structured analysis of available courses and of available literature. The recommendations describe 15 mandatory topics and 15 optional topics for a health IT evaluation course.

[1] Corresponding Author: Prof. Dr. Elske Ammenwerth, Institute of Biomedical Informatics, UMIT – University for Health Sciences, Medical Informatics and Technology, Eduard Wallnöfer Zentrum 1, 6060 Hall in Tirol, Austria, e-mail: elske.ammenwerth@umit.at

1. Introduction

High-quality and efficient health care seems not possible nowadays without the support of information technology (IT) [1]. Health IT has been shown to improve the quality and efficiency of clinical processes and health outcome, and to reduce morbidity, mortality and costs [2]. However the impact of health IT may not be optimal, and it can also pose risks to patient safety [3].

To verify that appropriate benefits are forthcoming and unintended side effects of health IT are avoided, systematic evaluation studies are needed to ensure system quality and safety, as part of an evidence-based health informatics approach [4, 5].

To guarantee that health IT evaluation studies are conducted in accordance with appropriate scientific and professional standards, well-trained health informatics specialists are needed. The recently updated recommendations of IMIA, the International Medical Informatics Association, on health informatics education [6] are that the topic "evaluation and assessment of information systems" should be part of health informatics curricula; arguably aspects of it should also be in wider health management and policy curricula so as to ensure achievement of an evidence-based approach in practice. However, the IMIA recommendations do not give details on what should be taught as part of a health informatics curriculum.

The objective of this contribution is to provide recommendations for the structure, scope and content of health IT evaluation courses.

2. Methods

The overall approach consisted of an iterative process of aggregating content from experts in the field, combined with an analysis of available courses and published literature. These activities were coordinated by the working groups on health IT evaluation of EFMI (European Federation for Health Informatics), IMIA and AMIA (American Medical Informatics Association).

First, structured descriptions of successfully running health IT evaluation courses from ten university courses in Europe, United States and Australia were collected [7], and their structure, scope and content analysed. Also, the core literature on health IT evaluation (e.g. [5, 8, 9]) was analysed regarding the covered content. Then, a workshop at Medical Informatics Europe (MIE2014) in Istanbul was organized with 30 participants where ideas for recommended core content for health IT evaluation were developed in a structured way. Results from the course analysis, literature analysis as well as from this workshop were aggregated to form a preliminary list of initial recommendations on core content as well as the structure and scope of the course. This list was verified by discussion among the authors of this contribution. The resulting draft recommendations comprised 33 content items.

A follow-up workshop at Medical Informatics Europe (MIE2015) in Madrid was organised. The 25 participants were asked to judge the importance of each of these content item (high, medium, low), and to identify possible missing content items. Overall, five new content items were proposed. An updated version of the recommendations was then prepared, where recommendations were now separated into

mandatory content (for those considered important by the participants) and optional content (for the rest).

The updated recommendations were then presented in a workshop at Medinfo 2015 in Sao Paolo. The 16 participants discussed whether the recommendations were clear and comprehensive. The resulting version of the recommendations consisted of 14 mandatory and 12 optional content items.

A follow-up workshop at AMIA 2015 in San Francisco with 15 participants was used to discuss the updated recommendations. Suggestions regarding optional content were added, alongside suggested clarifications. After this workshop, the updated version of the recommendations consisted of 15 mandatory and 15 optional content items. The recommendations were then finalized, based on the workshop results, among the authors as members of the EFMI, IMIA and AMIA Working Groups.

3. Recommendations for health IT evaluation courses

In these recommendations, the term "course" refers to an identifiable part of an overall degree programme, such as a module or a unit.

3.1. Structure and scope of the course

The recommendations are based on the following assumptions.
- **Focus of the course:** Theoretical & practical introduction into health IT evaluation.
- **Level of the course**: Master or postgraduate level.
- **Course objective:** Students should be able to: i) plan their own (smaller) evaluation study; ii) select and apply selected evaluation methods, iii) perform a study and report its results; and iv) be able to appraise the quality and the results of published health IT evaluation studies.
- **Scale of the course:** The mandatory core topics can be taught in a course of 6 ECTS (European Credit Transfer and Accumulation System[2]) which is equivalent to 4 U.S. credit hours[3]. U.S. programs may choose to offer the more standard 3-credit hour, semester long course. The duration of the course can be longer if optional content or extended practical training is added.
- **Format of the course:** Courses may be given in various module format and structure (e.g. traditional class room courses, blended learning courses, or fully online courses that follow best practices).
- **Participants:** The recommendations address multidisciplinary groups of students, with backgrounds for example in computer science, health informatics, medicine, nursing, social science, information sciences, or business.
- **Practical training:** The recommendations suggest that practical evaluation training is included; this training can focus on different aspects, depending on the learning objectives, the level of participants, and the available time.

---

[2] ECTS is a standard for comparing the study attainment and performance of students of higher education across Europe; 6 ECTS are equivalent to 150 hours of overall student workload (both classroom time and homework). 6 ECTS is roughly equivalent to 10% of an academic year.

[3] 1 credit hour = 50 minutes spend in class.

- **Prerequisites:** Before joining the health IT evaluation course, the students should have obtained sufficient background knowledge in the following basic research topics: Philosophy of science, scientific evidence, literature searching and critical appraisal, designing a research study, ethical principles, quantitative research methods and statistics, qualitative research methods, management of research projects, and clinical care delivery processes and health IT. If students do not have this knowledge beforehand, this needs to be added to a health IT evaluation course.

3.2. Content of the course

Table 1 presents the recommended core content.

Table 1. Recommendations for mandatory and optional content of health IT evaluation courses.

Mandatory core topics	
Theory	
A1	Need for evidence-based health informatics (i.e. health IT and patient safety, efficiency, quality, user satisfaction), and reasons for undertaking evaluations
A2	Theories of evaluation (e.g. inductive or deductive, formative or summative)
Practice	
A3	Building an evaluation study (e.g. information need, stakeholder analysis, tailor the evaluation, steps of an evaluation study, obtain permissions)
A4	Study designs for health IT evaluation studies (e.g. experimental, quasi-experimental, observational)
A5	Indicators for health IT quality (structure, process, outcome quality) and their relation to clinical indicators
A6	Practical training in health IT evaluation (e.g. write an evaluation plan based on a realistic case study; conduct a real evaluation project; discuss & criticize a published evaluation study). May comprise frontline evaluation work in health care organizations or health IT industry.
Methods and metrics	
A7	Measurement principles (e.g. objectivity, reliability, validity of measurements, types of bias)
A8	Quantitative data collection methods in health IT evaluation
A9	Qualitative data collection methods in health IT evaluation
A10	Multi-methods approaches and triangulation
A11	Quality of health IT evaluation studies
Reporting	
A12	Reporting and publishing of an evaluation study
A13	Finding, appraising and interpreting the evidence from published evaluation studies
A14	Answering "so what…" questions: What do evaluation results mean for IT management and for the quality and safety of clinical processes? How can evaluation results impact health IT practice?
Ethics	
A15	Obtaining ethical approval for evaluation projects and other required permissions
B Optional topics (examples to be chosen based on available time and background of participants)	
B1	Evaluation frameworks for health IT evaluation
B2	Evaluation of user and technology acceptance
B3	Evaluation of usability
B4	Technical evaluation (software testing)
B5	Evaluation of people and organizational impact
B6	Evaluation of clinical impact
B7	Economic evaluation
B8	Socio-technical and implementation-science approaches to evaluation
B9	Evaluation as part of quality and safety management and improvement frameworks
B10	Evaluation of data quality and data analytics
B11	Evaluation of health IT implementation
B12	Health Technology Assessment

B13	Systematic reviews and meta-analysis
B14	Simulation studies as an approach to evaluate health IT
B15	Regulatory issues impacting health IT evaluation

4. Discussion

This paper presents recommendations for a health IT evaluation course as part of a master or postgraduate programme. It describes the core content that can be covered within a 6 ECTS or 4 credit hours-course. If optional topics or extended practical training are added, more time will be needed. The development of the recommendations was coordinated by health IT evaluation experts from North America, Europe and Australia, all with teaching experience in academic settings. In addition, around 80 workshop participants contributed with their expertise to the discussions.

The recommended content should not be seen as a cookbook approach for deciding what should or should not be covered in a specific course. They also do not specify how many hours of lecturing should be invested in a given sub-topic. These decisions have to be done by lecturers and course planners based on overall programme objectives, learning objectives for the evaluation course, scientific or professional background of the students, content of undergraduate education, and available time. Indeed, the analysed evaluation courses [7] that are already running at various institutions are quite diverse.

The recommendations assume that all listed items are taught on an introductory level. Extended expert knowledge, for example in qualitative evaluation methods, could then be covered in subsequent specialised lectures. Also the listed optional topics could be taught in dedicated specialised lectures after a core module on health IT evaluation. It is also possible to split the recommended content into a basic course (3 ECTS) and an advanced course (3 ECTS), and then to add further specialised lectures. For planning these lectures, textbooks such as [5] may be found helpful.

Riding a bike cannot be taught by theory alone, health IT evaluation can only be learned by really "doing" it. Thus, we recommend including practical training – either on an individual basis or in interdisciplinary groups of students. When real evaluation projects are conducted by students, a good balance between the limited available time, the complexities of real-life evaluations and the need to provide meaningful evaluation results is often a challenge.

The recommendations list some research-related issues as prerequisites, such as designing a research study or research ethics. Here, good coordination of program content is needed to verify whether students had this content before. In case the students did not obtain this knowledge beforehand, this content needs to be added to the health IT evaluation course.

Follow-on activities which are desirable as part of this continuous educational development program are now: Consulting a wider stakeholder group on the recommendations; validating and if necessary improving the contents though use and review in academic practice; and in considering the distillation of a sub-set of the contents to form a module or course component on appreciation of health IT evidence and evaluation for inclusion in generic health management programs.

5. Conclusion

We provided recommendations for structure, scope and content of a health IT evaluation course that is taught as part of a masters or postgraduate education programme. We invite all teachers of health IT evaluation courses to use these recommendations when building or updating an evaluation course, and to add their course description to [7] and to report on experiences while implementing these recommendations. We also invite application and feedback on the use of the principles of this module as a means of instilling an evidence-based approach to health informatics application in wider health policy and health care delivery contexts.

Acknowledgment

References

[1] R. Haux, Medical informatics: past, present, future, *Int J Med Inform* 2010 **79**(9), 599-610.
[2] F. Lau, C. Kuziemsky, M. Price, J. Gardner, A review on systematic reviews of health information system studies, *J Am Med Inform Assoc* **17**(6) (2010), 637-45.
[3] Y.Y. Han, J.A. Carcillo, S.T. Venkataraman, R.S. Clark, R.S. Watson, T.C. Nguyen, H. Bayir, R.A. Orr, Unexpected increased mortality after implementation of a commercially sold computerized physician order entry system, *Pediatrics* **116**(6) (2005), 1506-12.
[4] M. Rigby, E. Ammenwerth, M. Beuscart-Zephir, J. Brender, H. Hyppönen, S. Melia, P. Nykänen, J. Talmon, N. de Keizer, Evidence Based Health Informatics: 10 years of efforts to promote the principle, *Yearb Med Inform* **8**(1) (2013), 34-46.
[5] E. Ammenwerth, M. Rigby, editors. *Evidence-based health informatics*. Stud Health Technol Inform. Amsterdam: IOS Press; 2016.
[6] J. Mantas, E. Ammenwerth, G. Demiris, A. Hasman, R. Haux, W. Hersh, E. Hovenga, K.C. Lun, H. Marin, F. Martin-Sanchez, G. Wright, Recommendations of the International Medical Informatics Association (IMIA) on Education in Biomedical and Health Informatics. First Revision, *Methods Inf Med* **49**(2) (2010), 105-120.
[7] EFMI WG Eval, *Curricula of health IT evaluation courses*, 2014 [accessed 2016, Jan-14, Available from: https://iig.umit.at/efmi/curricula.htm
[8] C. Friedman, J.C. Wyatt, *Evaluation Methods in Medical Informatics*, 2nd ed, Springer, New York, 2006.
[9] J. Brender, *Handbook of evaluation methods for health informatics*, Elsevier Academic Press, Burlington, MA, 2006.