# Bad Health Informatics Can Kill – Is Evaluation the Answer?

# Editorial

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## Summary

**Objective:** Health care is entering the age of information society. It is evident that the use of modern information and communication technology (ICT) offers tremendous opportunities to improve health care. However, there are also hazards associated with ICT in health care. We want to present an overview of typical hazards associated with ICT in health care, and to discuss how ICT evaluation can be a solution.

**Methods:** We analyze examples of failures and problems associated with ICT in health care. This collection is also made available on a website.

**Results and Conclusion:** Systematic, continuous evaluation of quality and effects of ICT during the whole life cycle of ICT components seems to be one important approach to detect and prevent possible ICT hazards and failures, supporting a higher quality of patient care. However, empirical studies proving this assumption are needed.

## Keywords

Health informatics, technology assessment, evaluation

## Information Technology in Health Care: Opportunities

Nowadays, it is hard to imagine health care without information and communication technology (ICT). Information technology in health care has existed for about five decades, and has gained widespread usage. Electronic patient records (EPR) offer health care professionals access to vast amounts of patient-related information, decision support systems support clinical actions, and knowledge servers allow direct access to state-of-the-art clinical knowledge to support evidence-based medical practice. ICT has helped to establish standardized healthcare-related communication protocols, which enable exchange of all kinds of information among health care parties. Networked health care environments are being developed in which regional health information systems support seamless care and thus enable provision of, and access to, health services and health related information across organizational, regional and national boundaries. Health care is indeed entering the age of information society [1, 2].

Introduction of ICT can radically affect health care organization, health care delivery and health care outcomes. It is evident that the use of modern ICT offers tremendous opportunities to support health care professionals and to increase the efficiency, effectiveness and appropriateness of care [3, 4].

## Information Technology in Health Care: Hazards

However, there can also be hazards associated with information communication technology in health care. ICT can be inappropriately specified, have functional errors, be unreliable, user-unfriendly, ill-functioning, or the environment may not be properly prepared to accommodate the ICT within the clinical working processes. Such breakdowns and failures may negatively affect the working processes and decisions of health care providers and may result in harm for the patients, i.e. ICT can create adverse side effects in the care process.

Inspired by a citation of Prof. Chris Taylor in the report "Pathways to Professionalism in Health Informatics" of the UK Council for Health Informatics Professions, the Working Group on Assessment of Health Information Systems of the European Federation of Medical Informatics (EFMI) initiated a web-based collection of examples where health ICT failed and lead to negative consequences. This web site called "Bad Health Informatics can kill" is available at http://www.umit.at/efmi. Consulting this website, which provides quite a few examples, you can get a feeling of the strong dependencies between quality of ICT systems and quality of patient care. This collection provides examples variously affecting the quality of patient care. For example, patients from Michigan being wrongly coded as dead on medical bills may be seen just as a minor problem not directly harming patients. But other examples show how insufficiently designed or customized ICT systems placed seemingly unbearable workload on clinical users, which in turn is felt to decrease the quality of patient care, e.g. by taking time away from direct patient care. Several examples of failed computerized physician order entry (CPOE) introductions may here be seen as an example. Health care processes more and more depend on a stable ICT infrastructure. Examples from repeated crashes of ICT systems or ICT networks show how dramatically this infrastructure affects patient care processes. For example: blocking access to vital patient information forced a large hospital to go back to ineffic-

ient paper-based documentation; or delaying answers to emergency calls due to problems with the emergency dispatching system in a large city may have led to delayed emergency treatment. A negative effect on patient safety seems at least possible in these examples, even though they are not often systematically reported.

Finally, the website presents examples of direct harm from ICT failures. One of the most cited examples is that of the Therac-25 incident in the late 1980s [5]. However, more recent examples are known where ICT has been demonstrated to harm or even kill patients. For example, software failures have led to radiation overdosing, inaccurate calculations of Down syndrome risk, incomplete bar coding of bags of blood; technology that is not sufficiently fault-tolerant to human errors has not detected wrong data entry, leading to wrong transplantation; or wrong identification of a patient leading to wrong treatment; or erroneously removing patients from cancer screening programmes leading to preventable deaths. Many of these negative examples have never been published in international scientific literature, perhaps due to the phenomenon called "negative publication bias". This makes it all the more important to collect these examples, as the EFMI working group is doing.

The cases listed on the website show in a rather drastic way the dependability of modern health care on the quality of information communication systems. Not surprisingly, several authors have tried to analyze such failures, to find reasons for the failures, and to provide solutions for how to prevent and overcome those failures (e.g. [6-13]). Those analyses often show that a combination of different reasons leads to failures of ICT and patient harm. Very often, human errors play an important role in the failures. However, this does not remove the necessity to build dependable, stable and fault-tolerant information systems.

## Can Evaluation Be the Solution?

The questions we should be asking ourselves therefore are: How can we design and implement systems that are free of errors, easy to use, and tolerant to human errors? How can we prevent negative side effects of information technology? How can we save lives?

Obviously, quality initiatives must start very early during the life cycle of information communication technology, and continue during specification, implementation, and operation. Therefore, systematic, continuous evaluation of information technology following the ICT life cycle is the "mots-clés" here.

'Evaluation' is often defined as the act of measuring quality characteristics of an object. However, those measures have no value in themselves – they need a context within which they are judged or used: there has to be a question to be answered. We, therefore, prefer to use the concept of 'evaluation' in the following sense as defined in [14]:

"Evaluation is the act of measuring or exploring properties of a health information system (in planning, development, implementation, or operation), the result of which informs a decision to be made concerning that system in a specific context."

## What Does a Stronger Focus on Evaluation Mean for Health Informatics?

Only continuous evaluation activities can generate information to improve knowledge and to generate insight to prevent and detect potential side effects of information technology. By doing this, evaluation of health information systems will ensure effective current health information systems, and contribute to better future ones. It is not sufficient to undertake evaluation only after the implementation of an information system. Evaluation has to be a continuous activity from its very inception. Any quality activity

(e.g. verification and validation during software development, testing and piloting during system implementation, and monitoring of adverse events and effects during operation) must be seen as an unavoidable part of a continuous evaluation strategy.

By this process, evaluation supports reflective practice. Every successful organization and conscientious practitioner evaluates the outcome of their decisions to see whether the intended goals were obtained. Evaluation of health information systems supports the continuous monitoring, review, and adjustment of their planning, development, implementation, and operation. By supporting reflective practice in health informatics in general, evaluation enables the emergence of an evidence-based health informatics profession.

In this sense, evaluation should be seen as an ethical imperative for health informaticians [15]. Information and communication systems and their applications are complex, commit scarce resources, and directly affect clinical staff and the delivery of patient care. From an ethical perspective, evaluation of health informatics systems (HIS) should have the same role in medical informatics as evidence and audit has in clinical care practice. Evaluation is not an academic playground, but the only way to reflect on the quality of that what we do.

This plea for evaluation is not new, as comparable argumentation e.g. in [9] or [16] shows. What we have to do now is to follow the recent recommendation of the Declaration of Innsbruck, as published in [14]. As such, we should: encourage the development and distribution of evaluation methods and evaluation guidelines by centers of excellence; motivate sufficient funding of evaluation activities in all implementation projects and during operation; establish interdisciplinary evaluation networks; integrate evaluation theory and practice in health informatics curricula; and motivate publication of evaluation results (both positive and negative) to enable health care institutions to learn from failures.

While these declaration recommendations seem sensible, and the rational underpinning self-evident, empirical investigations are missing to support the hypothesis that life-long continuous evaluation studies will improve the quality of information systems, reduce hazards and failures, and increase the quality of patient care. Such studies should be planned and conducted, either in a retrospective way, comparing implementation projects with and without a strong evaluation stream; or even prospectively, comparing the effects and the quality of a solution in implementation projects that are partly accompanied by evaluation activities, partly not.

However, despite the current lack of empirical proof, the presented evidence on the "Bad health informatics can kill" website strongly supports our conviction that a greater quantity of good quality evaluation activity can contribute to better health information systems, and hence to a higher quality of patient care. As Bend [17] suggests it is clear that to date we haven't been looking in the right places to determine success and failure. Without a doubt many healthcare ICT projects have gone underevaluated for a variety of reasons. It is time this changes. We therefore implore you to carefully consider, budget for and undertake quality evaluation even as the germ of a new ICT starts to seed.

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