

Health and Clinical Management – From the Pen and Paper to the Digital Era

Adapting the Healthcare Environment to Take Full Advantage of Information and Communication Technology

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Summary

Objectives: To present some of the recent best papers in the field of health and clinical management.

Methods: Synopsis of the best articles selected for the IMIA Yearbook 2011.

Results: Of the five selected articles, some confirm the benefits of processing standardized data, others demonstrate the value of adapting the healthcare environment with new technological devices to improve patient safety and healthcare professionals time-efficiency. Other fields are also embraced: the possibilities offered by today's communication technology open doors largely for telemedicine and remote patient monitoring.

Conclusions: In constant evolution, the healthcare environment has multiple challenges to meet: cost containment, increase and ageing of the population, enormous quantities of data and quickly evolving knowledge, complex and multi-disciplinary approaches for healthcare, need for safer care, to mention but a few. While health IT has already helped healthcare in facing these challenges, there still is much more that could be done.

Keywords

Medical informatics, International Medical Informatics Association, yearbook, health and clinical management, patient safety, telemedicine, technology in healthcare

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Introduction

The first medical records were handwritten and narrative, documented retrospectively and only for patients whose case was of greatest value for teaching. Things have evolved since [1] with systematic documentation of a medical record for all patients, normalized forms [e.g. for vital signs], structured medical records. This evolution was driven by the new knowledge that could be built upon the recorded information; the new knowledge leading to adaptation of health care practices which, in turn, are leading to new changes in medical records. Successive iterations of this process finally led to modern large medical records which reflect the huge amount of knowledge and the very complex multi-disciplinary medicine. Adding to this complexity is the necessity to provide efficient care: paper-based medical records and face-to-face communication are not optimal to deal with the increasing amount of data to be monitored, processed and distributed across all the providers acting in the patient care and populations' health.

As information and communication technologies (ICT) can offer solutions in storing, retrieving and processing data and communication technology can provide solutions in the transfer of information, it has stepped into healthcare a few decades ago [2]. Still, one should not be surprised that it did not yet deliver solutions to all challenges, that not all computing interventions have the desired positive effect [3], nor that

sometimes it is perceived as a burden and gives healthcare professionals the feeling of serving ICT instead of ICT serving them [4]. But most will agree, or at least hope, that computers are for healthcare as indispensable as Google is for searches, and as practical as smartphones [5]. One should not forget that medical informatics is, relative to most other medical specialities, a very young discipline [2].

While ICT has entered the healthcare domain because of healthcare's own evolution, some changes are, in turn, required in healthcare by ICT: medical records have to become electronic, further structured, much information has to be standardized, healthcare processes have to be understood [6], knowledge has to be made "machine understandable", new devices have to be adopted among many others. All-in-all, the entire healthcare environment is being adapted so that ICT can fully express their potential.

Best Paper Selection

The five papers selected for this yearbook are convincing examples of what can be achieved with today's technologies and tools. Although these cannot give a complete overview of all the challenges faced by medical informatics, they demonstrate promising results in topics such as patient security, time-efficiency improvement, patient triage, healthcare resource management, patient remote monitoring or bio-surveillance.

While all individuals should have the possibility to receive appropriate care, correct and efficient triage of patients is necessary. The triage of patients or cases that should receive specialized care from those not requiring it is one important step in reducing wasting of limited specialized resources' time. The paper published by Tan et al [7] demonstrates how tele-dermoscopy can successfully triage patients that do require specialized dermatologic evaluation from those not requiring it and that can be handled by primary care physicians. Further, for those patients clearly needing specialized follow-up, remote monitoring can avoid unnecessary visits. Remote monitoring, coupled to automatic critical events detection, offers healthcare providers the possibility to triage between those patients whose condition is as should be, and thus not requiring a consultation, and those needing attention. This is illustrated in the study by Varma et al. [8] with the evaluation of the impact on the delays for handling critical events and the reduction of patient visits for remotely monitored patients with implanted cardioverter defibrillator; a reduction of patient visits by a half, a drastic improvement in the time between critical event occurrence and consultation and no negative impact on patient morbidity is a demonstration of ICT's value for healthcare resources management.

In the field of disease surveillance, Leal's paper [9] on bloodstream infection regional monitoring illustrate the ability to automatically process large amounts of data, provided that data can be digitally available and standardized. Whereas manual identification of cases and chart review are a time consuming task, disease outbreaks and classification can be automatically performed by software with results similar to those obtained by manual review.

Reduction of preventable medical errors is another theme in which ICT is expected to have a significant impact. In the field of medication-related errors. While many studies have been published on CPOE and prescribing issues, the medication administration process has been less studied. Poon et al. [10] show that, with the introduction of a bar-code medication verification technology embedded in an eMAR, transcription of drug orders was made unnecessary, inappropriate timing administration errors were reduced by over 40% and potential

Table 1 Best paper selection of articles for the IMIA Yearbook of Medical Informatics 2011 in the section 'Health and Clinical Management'. The articles are listed in alphabetical order of the first author's surname.

Section
Health and Clinical Management
<ul style="list-style-type: none"> Leal J, Gregson DB, Ross T, Flemons WW, Church DL, Laupland KB. Development of a novel electronic surveillance system for monitoring of bloodstream infections. <i>Infect Control Hosp Epidemiol</i> 2010;31:740-7. Ohashi K, Ota S, Ohno-Machado L, Tanaka H. Smart medical environment at the point of care: auto-tracking clinical interventions at the bed side using RFID technology. <i>Comput Biol Med</i> 2010;40:545-54. Poon EG, Keohane CA, Yoon CS, Ditmore M, Bane A, Levitzion-Korach O, Moniz T, Rothschild JM, Kachalia AB, Hayes J, Churchill WW, Lipsitz S, Whittemore AD, Bates DW, Gandhi TK. Effect of bar-code technology on the safety of medication administration. <i>N Engl J Med</i> 2010;362:1698-707. Tan E, Yung A, Jameson M, Oakley A, Rademaker M. Successful triage of patients referred to a skin lesion clinic using teledermoscopy (IMAGE IT trial). <i>Br J Dermatol</i> 2010;162: 803-11. Varma N, Epstein AE, Irimpen A, Schweikert R, Love C, Investigators. T. R. U. S. T. Efficacy and safety of automatic remote monitoring for implantable cardioverter-defibrillator follow-up: the Lumos-T Safely Reduces Routine Office Device Follow-up (TRUST) trial. <i>Circulation</i> 2010;122,325-32.

adverse drug events were reduced by over 50%. While such a system can prevent early administration, late execution of interventions will more likely be addressed by targeting organisational aspects. Nevertheless, when dealing with time, technology may also play its part. This is illustrated by Ohashi and his colleagues [11] who have evaluated auto-tracking of patient bedside clinical interventions with the use of RFID tags. They have developed a system capable of automatically detecting the presence of patients, healthcare personal and material like iv medication bags, syringes and laboratory specimen tubes. While allowing for security checks (wrong patient / medication / specimen tube), their system showed an important decrease in time needed to perform routine clinical interventions. Their work clearly demonstrates that commonly available technology has a strong potential in reducing workload of health professionals.

Conclusions and Outlook

These excellent papers and their promising results are an encouragement for all to continue investing time, effort and resources to further the adoption of ICT and other technologies in healthcare. Even though a lot has already been achieved, there surely is much more still to be accomplished!

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Appendix: Content Summaries of Selected Best Papers for the IMIA Yearbook 2011, Section on Health and Clinical Management*

Leal J, Gregson DB, Ross T, Flemons WW,
 Church DL, Laupland KB

**Development of a novel electronic
 surveillance system for monitoring of
 bloodstream infections**

Infect Control Hosp Epidemiol 2010;31:740-7

In the domain of infection surveillance, this paper evaluates the performance of an electronic system for the identification and classification of bloodstream infections (BSI). By linking regional microbiology and hospital administrative databases and developing and applying query rules, authors have been able to achieve, as compared to manual chart review, very high sensitivity in detecting BSI, and a high degree of correlation in the classification by location of acquisition of BSI (community acquired, healthcare-associated community onset and nosocomial). Their work illustrates the value of IT for automated surveillance of disease spread.

Ohashi K, Ota S, Ohno-Machado L, Tanaka H
**Smart medical environment at the point of
 care: auto-tracking clinical interventions at
 the bedside using RFID technology**

Comput Biol Med 2010;40:545-54

In the domain of medication administration errors reduction and workflow time efficiency improvement, the present

study demonstrates with promising results how nowadays common technology's adoption plays an important role. By integrating RFID tags in patient and nurses' bracelets, patient bedside ceilings, at room entrances, on medical carts, iv poles, iv medication bags, blood sampling tubes and syringes, the authors have been able to automate the identification and localization of nurses and patients with auto-display of information depending on location, and automate the control of bedside interventions of iv medication administration (with auto-documentation of cancelled or interrupted administrations) and the blood sampling confirmation.

Poon EG, Keohane CA, Yoon CS, Dittmore M,
 Bane A, Levitzion-Korach O, Moniz T, Rothschild
 JM, Kachalia AB, Hayes J, Churchill WW, Lipsitz
 S, Whittemore AD, Bates DW, Gandhi TK

**Effect of bar-code technology on the safety of
 medication administration**

N Engl J Med 2010;362:1698-707

In this paper, authors present their results on medication administration errors reduction associated to the adoption of bar-code technology and an electronic medication administration record in 35 adult medical, surgical and intensive care units. Before and after implementation comparison of error rates showed a 27.3% reduction in timing errors rate and a 41.4% reduction in non-timing errors. The rate of potential adverse drug events fell by almost 51% after implementation of bar-code and eMAR and completely eliminated transcription errors.

Tan E, Yung A, Jameson M, Oakley A,
 Rademaker M

**Successful triage of patients referred to a
 skin lesion clinic using teledermoscopy
 (IMAGE IT trial)**

Br J Dermatol 2010;162: 803-11

The present study successfully tested the value of teledermoscopy as a triage tool for dermatology. 200 willing patients (with 491 lesions) addressed to a skin lesion clinic were initially seen by a trained melanographer who obtained a standardized history, demographic data,

melanoma risk factors and digital images of skin lesions of concern. Each patient was seen by 2 out of 3 dermatologists that examined patients clinically and with a hand-held dermatoscope. After a minimum period of 1 month, 2 dermatologists were asked to review the initial data collected by the melanographer and to give their diagnosis and management of the reviewed lesions. Analysis of data showed 12.3% of lesions with disparate diagnosis of clinical significance, 2.4% of lesions being under-reported by teledermoscopy and of those lesions with available histopathology, only 1 malignant lesion was shown to have been missed. Importantly, over 70% of lesions were determined as manageable by the general practitioner without need to be seen by a dermatologist. These results show that teledermoscopy as a triage tool can help reducing waiting lists and improve access to specialised healthcare when needed.

Varma N, Epstein AE, Irimpen A, Schweikert
 R, Love C, Investigators

**T. R. U. S. T. Efficacy and safety of automatic
 remote monitoring for implantable
 cardioverter-defibrillator follow-up: the
 Lumos-T Safely Reduces Routine Office
 Device Follow-up (TRUST) trial**

Circulation 2010;122:325-32

The present study evaluated the safety and efficiency of remote home monitoring (HM) of patients with implantable cardioverter defibrillators (ICD) compared to conventional in-clinic follow-up. HM was based on a wireless transmitter within the pulse generator that sent its data to a bedside communicator relaying it further to a service centre where data was processed and eventually generating warnings to clinicians. While the technical feasibility of such an intervention had previously been verified, authors evaluated its clinical benefits. Their results, very promising, showed a dramatic reduction in the delay of significant event detection (from 36 days in the convention follow-up group to <2 days in the HM group) and a 45% reduction in the total in-hospital device evaluation without affecting morbidity.

* The complete papers can be accessed in the Yearbook's full electronic version, provided that permission has been granted by the copyright holder(s).