

Health and Clinical Management – From Patient Care to National Public Health Increasing the Integration of all Health Care Participants and Systems Interoperability for Better Care Management

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Summary

Objectives: To present some of last year's best papers in the field of health and clinical management.

Method: Synopsis of the best articles selected for the IMIA Yearbook 2009.

Results: The selected articles illustrate how IT is enlarging its role in health care management. By getting closer to patients allowing them feeding systems with their health data, IT can improve patient health management directly at patients' home. With data being documented in increasingly more structured and standardized way, health information systems can better integrated and reuse that data and offer more decision support to physicians and other health professionals. Furthermore, as more data is available in electronic format in real-time, entire populations' health status can be monitored by public health authorities allowing for better public health management.

Conclusions: Although the selected articles are only a few bricks in global health management, they are promising examples of how IT improves the integration and collaboration between all participants in health care and offers support at all levels. Tying all these separate bricks together will still require work, as well as developing all the remain bricks, but systems interoperability allowing for data sharing and health participants collaboration are continuously getting more real.

Keywords

Medical informatics; International Medical Informatics Association; yearbook; decision support systems, management; patient care management; public health informatics

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Introduction

As information technology (IT) becomes increasingly more ubiquitous in health care, medical data is input in electronic health applications by almost all participants of the care process, ranging from institutional care providers to private practitioners and even by patients themselves [1, 2]. As one single patient interacts with an increasing number of care providers, it seems obvious that each provider should have access to all the data concerning that one patient, thus expecting systems to interoperate. But in order for systems to efficiently collaborate, they need to exchange meaningful data that is, they need to use the same semantics [3, 4].

As electronic health information systems are asked to provide increasingly more help in health care management, they become more complex. It is no more sufficient for systems to store data and make it available for retrieval on user request, but they are asked to bring proactive decision support, at many levels. For such functionality, when data is made available in a system, that data should be notified to any component of the system that might make use of it. For example, as a positive result from laboratory tests for a notifiable disease is available, the system can be expected to extract from the electronic patient record all the data relevant for the notification of that disease and automatically report the case to the surveillance authority [5]. When new laboratory data suggesting renal insuffi-

ciency are available, the system should, if pertinent, readily suggest the physician to adapt the dosage of relevant drugs already prescribed for the patient and not use that laboratory results only for future prescriptions that will be made. Such data reusability across a platform is of particular value as health-care is evermore multidisciplinary which requires better data integration and communication among the various providers [6].

Such functionalities, although of great help in patients' health care management, make systems increasingly more complex as any given component of the system may be impacted by any kind of data from virtually any other component of the system. Thus the components of one given system need to interoperate.

With an increasing number of electronically available medical data, IT has an increasing potential in helping in health care management. But as the systems become more complex and are expected to deliver increasingly more complex expertise, the goals are still challenging.

Best Paper Selection

Each of the five papers selected for this yearbook focus on different aspects of health care management. Ranging from single patient's health care management at home to national health surveillance, through health information systems

design and analysis, these articles give a nice overview of what IT offers in health care.

The importance of patient's direct involvement in the health care process, particularly in chronic disease management, makes no doubt. In the continuation of some studies that evaluated IT interventions for home monitoring of patients with chronic disease like diabetes [7] or hypertension [8], last year's study by O'Shea [9] showed promising results in the management of outpatients' oral anti-coagulation treatment with the help of a computerized expert system, and further enhances the role IT will play at the patient's side.

At the inpatient level, IT is expected to help clinicians manage the increasing amount of data collected about their patients. Meystre's paper [10] is a good example of how valuable clinical data can be extracted from electronic documents and put in front of physician's attention, thus reducing the risk of information being overlooked and reducing the time for specific conditions being taken in consideration.

From helping single patient's in the management of their health, to helping drawing physicians' attention at valuable information, IT now even helps in entire national population's surveillance. While tools aimed at grouping ICPC-coded diagnoses from general practice physicians' electronic medical records show promising results [11], thus opening perspectives for better surveillance of incidence and prevalence of diseases in general population, Wu et al. [12] present in their paper how a national epidemic real-time surveillance system was set in Taiwan, based on data collected in the country's hospitals' emergency departments.

Among the benefits IT is expected to bring in health care management, reduction in medical errors is another one. In the particular area of medication-related errors, CPOE plays an important role. A lot has been published on this topic, particularly after that Han et al. [13] found, in 2005, an increased mortality rate after implementation of

Table 1 Best paper selection of articles for the IMIA Yearbook of Medical Informatics 2009 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"> ▪ Meystre SM, Haug PJ. Randomized controlled trial of an automated problem list with improved sensitivity. <i>Int J Med Inform</i> 2008 Sep;77(9):602-12. ▪ O'Shea SI, Arcasoy MO, Samsa G, Cummings SE, Thames EH, Surwit RS, Ortel TL. Direct-to-patient expert system and home INR monitoring improves control of oral anticoagulation. <i>J Thromb Thrombolysis</i> 2008 Aug;26(1):14-21. ▪ Van Hoecke S, Decruyenaere J, Danneels C, Taveirne K, Colpaert K, Hoste E, Dhoedt B, De Turck F. Service-oriented subscription management of medical decision data in the intensive care unit. <i>Methods Inf Med</i> 2008;47(4):364-80. ▪ Walsh KE, Landrigan CP, Adams WG, Vinci RJ, Chessare JB, Cooper MR, Hebert PM, Schainker EG, McLaughlin TJ, Bauchner H. Effect of computer order entry on prevention of serious medication errors in hospitalized children. <i>Pediatrics</i> 2008 Mar;121(3):e421-7. ▪ Wu TS, Shih FY, Yen MY, Wu JS, Lu SW, Chang KC, Hsiung C, Chou JH, Chu YT, Chang H, Chiu CH, Tsui FC, Wagner MM, Su JJ, King CC. Establishing a nationwide emergency department-based syndromic surveillance system for better public health responses in Taiwan. <i>BMC Public Health</i> 2008 Jan 18;8:18.

a CPOE in a paediatric setting. On the medication-related adverse events, it is worth highlighting Walsh's paper on a comprehensive analysis of such events [14] as it gives a better understanding of the king of tailoring a system may need in a specific context so it can better reach its goals.

Finally, the last selected article takes an insight in system architecture. Although Van Hoecke et al. focused on the design of a platform for management of medical decision data in the ICU for easier integration of the growing number of medical decision support services [15], their work is valuable as their approach is valid for other settings outside the ICU. In fact, their approach is very interesting for designing entire health information system as it might help deal with their evermore higher complexity.

Conclusions and Outlook

Although all the work published last year in the field of health and clinical management is much more than can be summarized here, the five selected articles cover a broad range of the topic. They not only present promising results, but convincingly illustrate how IT can bring substantial help at

the many different levels of health and clinical management.

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References

1. Mandl KD, Kohane IS. Tectonic Shifts in the Health Information Economy. *N Engl J Med* 2008 Apr 17; 358(16):1732-7.
2. Eysenbach G. Medicine 2.0: social networking, collaboration, participation, apomediation, and openness. *J Med Internet Res* 2008 Aug 25; 10(3):e22.
3. Lopez DM, Blobel BG. A development framework for semantically interoperable health information systems. *Int J Med Inform* 2009 Feb;78(2): 83-103.
4. Kush RD, Helton E, Rockhold FW, Hardison CD. Electronic Health Records, Medical Research, and the Tower of Babel. *N Engl J Med* 2008 Apr 17; 358(16):1738-40.
5. Lazarus R, Klompas M, Campion FX, McNabb SJ, Hou X, Daniel J, Haney G, et al. Electronic Support for Public Health: Validated Case Finding and Reporting for Notifiable Diseases Using Electronic Medical Data. *J Am Med Inform Assoc* 2009;16(1):18-24.
6. Wong HJ, Caesar M, Bandali S, Agnew J, Abrams H. Electronic inpatient whiteboards: Improving multidisciplinary communication and coordination of care. *Int J Med Inform* 2009 Apr;78(4):239-47.
7. Kim SU, Kim HS. Effectiveness of mobile and internet intervention in patients with obese type 2 diabetes. *Int J Med Inform* 2008 Jun;77(6): 399-404.

8. Logan AG, McIssac WJ, Tisler A, Irvine MJ, Saunders A, Dunai A, et al. Mobile Phone-Based Remote Patient Monitoring System for Management of Hypertension in Diabetic Patients. *Am J Hypertens* 2007;20(9):942-8.
9. O'Shea AI, Arcasoy MO, Samsa G, Cummings SE, Thames EH, Surwit RA, et al. Direct-to-patient expert system and home INR monitoring improves control of oral anticoagulation. *J Thromb Thrombolysis* 2008 Aug;26(1):14-21.
10. Meystre SM, Haug PJ. Randomized controlled trial of an automated problem list with improved sensitivity. *Int J Med Inform* 2008 Sep;77(9):602-12.
11. Biermansa MC, De Bakkerb DH, Verheij RA, Gravesteinb JV, Van der Linden MW, Robbé PF. Development of a case-based system for grouping diagnoses in general practice. *Int J Med Inform* 2008 Jul;77(7):431-9.
12. Wu, TJ, Shih FF, Yen M, Wu JJ, Lu SW, Chang KC, et al. Establishing a nationwide emergency department-based syndromic surveillance system for better public health responses in Taiwan. *BMC Public Health* 2008 Jan 18;8:18.
13. Han YY, Carcillo JA, Venkataraman ST, Clark RS, Watson RS, Nguyen TC et al. Unexpected increased mortality after implementation of a commercially sold computerized physician order entry system. *Pediatrics* 2005;116(6):1506-12
14. Walsh KE, Landrigan CP, Adams WG, Vinci RJ, Chessare JB, Cooper MR, et al. Effect of Computer Order Entry on Prevention of Serious Medication Errors in Hospitalized Children. *Pediatrics* 2008 Mar;121(3):e421-7.
15. Van Hoecke S, Decruyenaere J, Danneels C, Taveirne K, Colpaert K, Hoste E, et al. Service-oriented Subscription Management of Medical Decision Data in the Intensive Care Unit. *Methods Inf Med* 2008; 47(4):364-80.

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Appendix: Content Summaries of Selected Best Papers for the IMIA Yearbook 2008, Section on Health and Clinical Management*

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

Meystre SM, Haug PJ

Randomized controlled trial of an automated problem list with improved sensitivity *Int J Med Inform* 2008 Sep;77(9):602-12

Patient problems list provide clinicians with a concise view of their patient's medical conditions and encourage better patient health management. In this paper, authors present their research in improving the completeness and timeliness of patients' problems list. They use NLP to retrieve from electronic free-text documents in the patient record the possible presence of any one of 80 targeted problems and propose physicians adding them in the patients' problems list. Through the use of their tool, the completeness of the problem list was greatly improved (from 9% to 41%) as well as the timeliness of problems being added to the problem list (from 6 to 2 days). Further analysis showed that the sensitivity of the automatically extracted problems would even reach 77%, had the physicians not been asked to validate to propositions, with a minor loss of specificity, lowering just from 100% to 96%.

O'Shea AI, Arcasoy MO, Samsa G, Cummings SE, Thames EH, Surwit RA, Ortel TL

Direct-to-patient expert system and home INR monitoring improves control of oral anticoagulation *J Thromb Thrombolysis* 2008 Aug;26(1):14-21

Oral anticoagulation, an increasingly more frequent treatment in the outpatient population, requires frequent INR monitoring. Although home INR monitoring devices are available, patients still need to visit their physician so that the treatment efficiency can be assessed and drug dosage adapted. In this paper, authors present their work on developing an internet-based, supervised, expert system for monitoring oral anticoagulation efficiency. Patients used a home INR monitoring device and logged their INR values in the system, as well as eventual clinical symptoms related to

anticoagulation side-effects. In return, the system suggested patients the date for the next INR self-check and dosage recommendations until then, eventually after a physician's approval in case of important INR deviations.

Their experience showed an increase in the time in oral anti-coagulation therapeutic interval compared to patients followed in an oral anticoagulation clinic.

Van Hoecke S, Decruyenaere J, Danneels C, Taveirne K, Colpaert K, Hoste E, Dhoedt B, De Turck F

Service-oriented Subscription Management of Medical Decision Data in the Intensive Care Unit *Methods Inf Med* 2008;47(4):364-80

In this paper, the authors expose their work on the development of a platform designed to provide medical decision support services with the general functionalities including patients' subscription to these services, service localization, medical decision data retrieving, medical support service messages delivery and service resource management. Provided with all these general functionalities, medical decision support services' development and integration within a HIS is made easier as they need to implement only their core business logic.

Although the platform was developed for the ICU setting, it can be further extended to other environments. The approach could be used for entire hospital information system.

Walsh KE, Landrigan CP, Adams WG, Vinci RJ, Chessare JB, Cooper MR, Hebert PM, Schainker EG, McLaughlin TJ, Bauchner H Effect of Computer Order Entry on Prevention of Serious Medication Errors in Hospitalized Children *Pediatrics* 2008 Mar;121(3):e421-7

Although CPOE is now largely used and their global benefits, including preventing medication errors, recognized,

some controversial results, particularly in the paediatric setting, have been found. The authors present their work on a comprehensive evaluation of medication errors before and after a commercial CPOE system implementation in a paediatric setting.

Their analyses found that incomplete or wrong medication orders were significantly lower after CPOE implementation, as could be expected of a CPOE system, whereas errors related to drug dosage slightly increased after CPOE implementation. Analysing the type of medication dose error showed that although the studied CPOE system had a weight-based automatic dose-checking, the system was not properly designed

to address drug under-dosing, particularly relevant in the paediatric setting.

Wu, TJ, Shih FF, Yen M, Wu JJ, Lu SW, Chang KC, Hsiung C, Chou J, Chu, Y, Chang H, Chiu C, Tsui FR, Wagner MM, Su I, King C

Establishing a nationwide emergency department-based syndromic surveillance system for better public health responses in Taiwan

BMC Public Health 2008 Jan 18;8:18

This paper presents the development of an emergency department-based nation-wide real-time syndromic surveillance system in Taiwan where about 80% of hospitals distributed all over the

country have electronic health information systems. Collected data came from nurses' triage stations and physicians' clinical assessments and included demographic data such as date of birth or home zip-code and clinical data such as body temperature, triage categories, chief complaints diagnostic ICD-9 codes.

Data analysis showed some not previously detected situations like a summer peak in visits for influenza-like syndrome before the annual vaccination campaign thus giving valuable information for public health care management.