Health and Clinical Management: 
Chronic and Acute Challenges

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Introduction

Quite understandably, anyone that has suffered illness has wished for a rapid and efficient cure. In order to meet this patients’ desire, healthcare providers have sought to increase their knowledge about diseases, their diagnosis and treatment. This can be summarized as a pressure on healthcare to improve its outcomes; a pressure that has existed and will exist for long times and that is addressed primarily by fundamental and clinical research to acquire knowledge. Because of humans’ intrinsically limited memory and capacity to deal with large amounts of information, and in order to respond to this knowledge increase, physicians and all other health providers have been progressively forced to specialize in increasingly more specific domains. While this specialization of healthcare actors is an efficient response for those patients suffering a single disease involving a single speciality (e.g. a young and healthy patient that has broken a leg only requires an orthopaedist), it does have its counterparts. With an aging society, an ever increasing number of patients suffer multiple and chronic diseases spanning across many specialities (e.g. diabetic patients with ophthalmologic, nephrologic and cardiovascular complications). Such patients therefore need to receive care that has to be provided by many actors. This finally leads to a dispersion of information about patients’ health condition across many institutions and health workers. Because making the best decisions requires to be well informed, solutions must be found to avoid this fragmentation of information in order to improve each health professional’s awareness of all relevant information for his patients [1-4].

The resulting today’s healthcare environment is extremely complex: enormous quantity of knowledge that can hardly be handled even by the best specialists, increasing number of patients suffering of chronic and complex diseases for which many professionals need to collaborate together or simply the ever increasing number of diagnostic and therapeutic options are just a few aspects of the complexity.

Now, while this modern healthcare environment is pressured to improve outcomes, which is already challenging enough by itself, recent years have put it under a new and acute stress: reduce, or at least contain, its costs. Because increasing the number of healthcare workers has a direct impact on costs and wouldn’t help deal with the complexity of patient care, solutions must be searched for elsewhere. To improve outcomes requires the ability to take advantage of all the most up-to-date knowledge and all the information relevant to a patient’s condition and to improve cost efficiency requires an accurate targeting of those patients that will benefit from a healthcare intervention. Due to its capacity to reliably and rapidly process massive quantity of information, evaluate complex equations and conditions and instantly deliver results to numerous recipients, IT has, since many years, proved to be of valuable help in these areas.

Summary

Objectives: Summarize some of last year’s best research in the field of Health and Clinical Management.
Method: Synopsis of articles selected for the IMIA Yearbook 2012.
Results: Five articles, from international peer-reviewed journals, have been selected in this section.
Conclusions: The selected articles illustrate some of the topics of health and clinical management: from patient safety issues over the possibilities offered by technological devices to building knowledge from data present in electronic patient records.

Keywords
Medical Informatics; International Medical Informatics Association; Yearbook; Management; Patient Care Management; Public Health Informatics

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The few challenges presented here are usually captured in a structured way, unstructured data also conveys valuable information. By mining clinical notes, authors have been able to extract “hidden” information that significantly enriched coded data and resulted on finer patient profiles from which unexpected disease co-occurrence. Finally, analysis of these co-occurring diseases allows the construction of gene/protein networks.

The fourth article, by Tatonetti et al. [11], is in the field building knowledge on adverse drug events. While knowledge about drugs, mainly their indications, contra-indications and secondary effects, is mostly studied on isolated drugs, knowledge about drug-drug interactions (DDIs) is still scarce. This research aimed to search for evidence of DDIs in the FDA’s Adverse Event Reporting system. By mining this database, nearly 200 novel DDIs have been discovered and among them an interaction between pravastatin and pravastatin, two among the most widely used drugs in the world.

Finally, the last selected article, by Waitman et al. [12], is another good example of IT’s valuable help in healthcare management. Significant efforts have been made in recent years to reduce adverse drug events: CPOEs with clinical decision support and alerting mechanisms have been developed and implemented and coupled to electronic dispensation systems and medication administration records. Despite this effort, preventable adverse drug events (ADEs) still continue to cause harm to patients. In this paper, authors present a new approach to prevent ADEs: as a complement to CPOE and EHR, define rules to identify patients at risk for an ADE and present these patients on dashboards reviewed by pharmacists.

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References

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Appendix: Content Summaries of Selected Best Papers for the IMIA Yearbook 2012, Section on Health and Clinical Management

Chang YT, Syed-Abdul S, Tsai CY, Li YC
A novel method for inferring RFID tag reader recordings into clinical events

Roque et al. present their work on inferring RFID tag reader recordings into clinical events. The model was built and evaluated in a Clinical Skill Center and aimed to detect and differentiate close-in, contact, and invasive events between caregivers and patients. Based on observations, invasive events were easily distinguishable as their duration and the number of caregivers involved would be greater than for other types of events and nurses would be assisting doctors. To distinguish close-in and contact activities, the authors used an ROC curve to compute the best cut-off value in their setting (21s). The model was then validated in an ICU ward by comparing the automated RFID tag recordings with real-time observation. Results had good sensitivity, specificity and accuracy in detecting and differentiating event types; invasive events being the most accurately detected with a 91% sensitivity and a 98% specificity.

Robicsek et al. present their work on electronic prediction rules for methicillin-resistant Staphylococcus aureus colonization. Int J Med Inform 2011 Dec;80(12):872-80

Avoiding nosocomial infections are one of the many events of concern in respect to patients’ safety, particularly with the emergence of multi-resistant microbial agents. Contact between healthcare givers and patients being one of the main causes of cross-infection, there is a demand for a reliable monitoring and health professionals in the hospital setting. In this article, the authors present their work on setting up, evaluating and validating a Contact History Inferential Model through the use of radiofrequency identification tags for proximity sensing. The model was built and evaluated in a Clinical Skill Center and aimed to detect and differentiate close-in, contact, and invasive events between caregivers and patients. Based on observations, invasive events were easily distinguishable as their duration and the number of caregivers involved would be greater than for other types of events and nurses would be assisting doctors. To distinguish close-in and contact activities, the authors used an ROC curve to compute the best cut-off value in their setting (21s). The model was then validated in an ICU ward by comparing the automated RFID tag recordings with real-time observation. Results had good sensitivity, specificity and accuracy in detecting and differentiating event types; invasive events being the most accurately detected with a 91% sensitivity and a 98% specificity.

Robicsek et al. present their work on electronic prediction rules for methicillin-resistant Staphylococcus aureus colonization. Int J Med Inform 2011 Dec;80(12):872-80

Isolation of methicillin-resistant Staphylococcus aureus carrying patients is a worldwide hospitals’ effort in order to reduce cross-patient contamination. The identification of such patients is costly and resource demanding; it requires the testing of a large proportion of all the patients in order to achieve a reasonable rate of detection and to have an impact. While testing all patients for MRSA colonization is a costlier method, testing only a targeted population requires an efficient rule to identify that target population; furthermore, if the rule is to be applied by caregivers, it must not only be efficient but also simple to evaluate. Unfortunately, the simpler the rule, the lesser is the discrimination between low- and high-risk patients. With the increasing availability of data in hospital information systems, simple prediction rules can be superseded with complex but computer evaluated ones.

Electronic patient records contain vast amounts of health related data. These

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Interactions between drugs (DDIs) are difficult to study. Clinical trials focus on establishing the safety and efficacy of single drugs and typically do not investigate DDIs. While some drug interactions can be predicted through careful evaluation of molecular targets and metabolizing enzymes (e.g., CYP3A4), drugs may also interact with proteins that are not their primary therapeutic target. Thus, few predictive methods for discovering novel DDIs exist.

Spontaneous reporting systems, like the FDA’s Adverse Event Reporting System routinely collect ADEs from clinicians, patients and drug companies and thus provide an opportunity to discover unexpected drug interactions. This paper describes the authors work on analysing the reports on ADEs in the FDA’s database for discovering new drug–drug interactions. Focus was given on eight distinct severe adverse event classes based on their clinical significance. Of all reports available in the FDA’s database, two sets of reports were extracted: the first, the training set, comprised only reports listing exactly one drug and the second, the validation set, included all reports listing exactly two drugs. The probability of occurrence of an adverse event was calculated for each drug based on the “single drug” adverse event reports. This derived probability was then compared to the calculated probability in the “two drugs” adverse event reports and lead to the identification of nearly 200 novel drug–drug interactions. Of these, the interaction between paroxetine and pravastatin, two among the most widely used drugs in the world, was verified in an independent analysis of the Stanford Hospital electronic medical records proving the value of their signal detection algorithm.

Although the use of drugs for treating patients is inevitable in medicine, drugs have been recognized to cause adverse events in a significant number of cases. The medical literature available during the past decades has shown that the magnitude of injury and the cost to society was such that it has led to a call for action. It has also shown that adverse drug events can have their origin anywhere on the path from prescription to administration over dispensing.

Available knowledge about ADEs and the circumstances of their advent has promoted computerization of the medication process. Unfortunately, even with CPOEs coupled to electronic dispensation and administration monitoring systems still allow adverse drug events to occur.

In order to further improve patient safety and healthcare quality, the authors present their study on implementing a real-time surveillance application designed to enable pharmacy review of high-alert medication orders and complement existing computerized provider order entry and integrated clinical decision support systems. The surveillance tool, targeting specific high-risk medications, integrated real-time data from multiple clinical systems and applied logical criteria to highlight potentially high-risk scenarios.

An analysis of the use by pharmacists of the developed application was done for aminoglycosides, warfarin, and anticoagulants (heparin and enoxaparin). It showed that event in the presence of a computerized provider order entry and clinical decision support, such real-time surveillance dashboards can serve as a final safety net to intercept medication errors.