INTEGRATING ELECTRONIC HEALTH RECORDS WITH MEDICAL EVIDENCES DATABASES: A LITERATURE REVIEW

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Abstract: By facilitating access to information and improving data quality, electronic health records (EHR) are expected to achieve better quality in the treatment of patients than paper-based systems. Another way that information technology is expected to improve patient assistance is by supporting evidence-based practice, in which the health professionals are able to access evidence databases containing synthesized and appraised medical literature. Nevertheless, these two uses of health information technology are usually disjoint, since there is a large semantic distance between bibliographic classification headings and clinical terms used in health records. This study offers a review on efforts to integrate EHR and evidence databases, a critical step towards the integration of efficient clinical decision support systems.

Keywords: Decision Support Systems Clinical, Evidence-Based Practice, Electronic Health Records.

Introduction

With the progress of medical knowledge and technology around the world, a great deal of new literature and other evidences about medical treatments are being published. These recent publications provide the methods or evidences to support clinicians’ decisions, which is the essence of Evidence-Based Medicine (EBM). Stored in knowledge repositories known as evidence databases, they help to improve medical quality and promote competitive advantage in the health industry. When these databases are available in the point of care, physicians may access crucial evidence-based literature that helps to take a clinical decision based on their experience and supported by the best available evidence. By computerizing the access to health information, it is possible to avoid dangerous medical mistakes, reduce costs, and improve assistance care. However, it is rarely practiced because few physicians have time to critically appraise the medical literature and to access evidence databases.

Actual practice of EBM would require clinicians to formulate carefully structured questions about clinical problems related to specific patients, and then to perform medical literature searches to find valid clinical studies, such as randomized controlled clinical trials,
containing individuals who are representative of the patient being treated. Obviously, this is a very time-consum ing process which rarely is performed.

One important positive aspect of EBM realization is to encourage physicians to convert their tacit knowledge and clinical experience into explicit knowledge, as well as to help to create a shared language where physicians easily reach consensus and eliminate dispute among them. EBM also provides a novel learning way based on continuing education, since it is continuously developed. However, physicians need efficient tools for retrieving the knowledge and to solve the problems. Such needs are expected to increase with the integration of genomic information to electronic health records (EHR) in the near future.

Methods

The literature review was performed based on the principles of systematic reviews, as stated in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework.

The first step in this framework is to define relevant concepts for this work. In this case, there were two concepts.

Electronic Health Records: In the scope note associated to this MeSH heading, the U.S. National Library of Medicine defines this as the “media that facilitate transportability of pertinent information concerning patient’s illness across varied providers and geographic locations. Some versions include direct linkages to online consumer health information that is relevant to the health conditions and treatments related to a specific patient”. The International Organization for Standardization (ISO) provides a more comprehensive definition: “a repository of information regarding the health status of a subject of care in computer processable form, stored and transmitted securely, and accessible by multiple authorised users. It has a standardised or commonly agreed logical information model which is independent of EHR systems. Its primary purpose is the support of continuing, efficient and quality integrated health care and it contains information which is retrospective, concurrent, and prospective”.

Evidence-Based Medicine: In this case, the NLM reports to the literature to provide a definition for this MeSH heading: “An approach of practicing medicine with the goal to improve and evaluate patient care. It requires the judicious integration of best research evidence with the patient’s values to make decisions about medical care. This method is to help physicians make proper diagnosis, devise best testing plan, choose best treatment and methods of disease prevention, as well as develop guidelines for large groups of patients with the same disease (from JAMA 296 (9), 2006)”.

The next step is to evaluate whether there are synonym terms that should be included in the search queries, as a strategy to avoid missing relevant results. In this case, “electronic patient health record” was considered to be equivalent to electronic health record, and “evidence-based practice” was considered equivalent to evidence-based medicine.

After establishing these definitions, the searches are performed in the selected bibliographic databases. In this study, PubMed (http://www.ncbi.nlm.nih.gov/pubmed/) and IEEEExplore (http://ieeexplore.ieee.org/) were selected. The search itself is structured by combining the synonym terms in lists with the OR logical connector, and then grouping these lists with the AND logical connector, taking in account the rules for each engine search. For example, for the PubMed bibliographic database, the structured query was:
From these searches, 172 articles were retrieved from PubMed, 27 from IEEEExplore, and 2 from other sources (ACM Digital Library), totaling 201 papers. One of these papers appeared in two databases; with the duplicate removal, 200 papers were left for consideration.

At this point, the next step in the PRISMA framework is to screen the results to verify whether how many articles are indeed related to the search goals. This was performed initially by screening over the paper titles, which yielded to the exclusion of 176 papers. From the remaining 22 articles, 11 were excluded after reading the abstract and 3 because the full paper was not available. To the remaining 8 articles, 2 were added from previous manual searches. Figure 1 summarizes the application of the PRISMA framework in this study.

Figure 1: PRISMA flowchart for the literature search

Results

In this section, we synthesize the results found in the literature as described previously. The scenario which integrates EHR and EBM might create several expectations towards the development of better clinical decision support system and to provide cost-
effective treatments for patients. However, Walsh et al. stated that, in a study in the context of heart failure care, EHR did not achieve greater improvements in quality when compared to practices using paper systems\(^4\), which raise doubts about the possibility to justify the funding for the development of these integrated-based systems.

However, there are also cases of success. November describes the Intermountain project as an example of a system that offers high-quality of care and reduce costs, after decades of using technology as an ally to their institutional health information management systems\(^6\). Giuse et al. describe how the Vanderbilt University Medical Center has achieved scalable integration between their own medical evidence-based libraries, which they constantly update, and StarPanel, Vanderbilt electronic medical record system\(^7\).

Debar et al. analyze the use of calculators, which synthesize the knowledge present in evidences, in the process of cardiovascular risk assessment. They claim that the heterogeneity at each stage of this process brings difficult for the health professionals, as there is a gap between clinical evidence and practice, since different implementations of calculators used in distinct stages not always agree, even when based on the same set of guidelines\(^8\).

An article by Chiu\(^9\) discuss advantages and disadvantages related to the use of EBM in the daily work of the physicians. These results are summarized at Table 1.

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<th>Advantages/Positiveness</th>
<th>Disadvantages/Negativism</th>
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<tr>
<td><strong>Support:</strong> to acquire, identify and apply knowledge stored in EBM databases.</td>
<td><strong>Load:</strong> of information and pressure of keep acquiring knowledge without systematic method.</td>
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<tr>
<td><strong>Quality:</strong></td>
<td><strong>Carelessness:</strong> junior physicians put more emphasis on the best evidence, their clinical practice is almost centralized on evidences. The senior physicians, however work based on their clinical expertise.</td>
</tr>
<tr>
<td>• Breadth: diversity, internationalization and update.</td>
<td><strong>Abuse:</strong> some physicians, who cannot find the matched cases, carelessly apply similar cases to their patients, this may result in wrong treatment.</td>
</tr>
<tr>
<td>• Depth: the EBM databases are rigorous and systematic created.</td>
<td><strong>Information anxiety:</strong> sometimes the physicians are afraid that the evidences they retrieved are not appropriate for the patients.</td>
</tr>
<tr>
<td>• Correctness: the EBM papers have high validity.</td>
<td><strong>Omnipotent myth:</strong> several physicians pointed out that there are rare cases of complete match with their patients in EBM databases.</td>
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Boudin et al. state that the most critical aspect in information retrieval (IR) is term weighting, and for that reason they address the use of evidence as an IR problem\(^11\). They describe that EBM is associated to a systematic search of all the available literature and the search could be a time consuming activity. In order to create the repositories, physicians are educated to formulate their clinical questions according to several well defined aspects in
EBM, known as the PICO elements: patient/Problem (P), Intervention (I), Comparison (C) and Outcome (O). It is not easy to identify PICO elements in documents, so they propose an approach to determine term weights according to the document structure.

Discussion

This literature review has shown that there is no clear association between the adoption of electronic health records and evidence-based practice, and that efforts to provide a seamless integration between EHR and evidence databases are still immature.

Future research in this direction should address the relationship between technology adoption in health practice and the (mainly cultural) barriers pointed out in Table 1. Without attention to these issues, any technological solution to integrate EHR and EBM, as ingenious as it can be, is at risk of not being adopted.

Conclusion

Electronic Health Records and Evidence-Based Medicine are two contributions from information technology to health assistance and clinical practice. Nevertheless, there is not enough research to assess whether EHR adoption helps to promote EBM or whether EBM adopters favor the use of EHR. This study pointed out, through a literature review, what health practitioners envision as benefits and barriers to this integrated adoption of EHR and EBM.

One suggestion for future research is to make a mixed study, composed by a quantitative survey followed by qualitative analyses of interviews, among health professionals targeting specifically this possible integration. From the results of this study, developers could extract requirements to be addressed in future implementations of Clinical Decision Support Systems integrating EHR and evidence databases. In this direction, our future work will include the study of current solutions to integrate literature articles that are the source for evidences, described usually by terms from MeSH, with the content of health records, which are better described by clinical terms from SNOMED.

References


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