M. Kimura

Hamamatsu University, School of Medicine
Department of Medical Informatics
Hamamatsu, Japan

Synopsis

What can we currently expect from patient records?

1. What purpose do patient records serve?

Originally, patient records were for maintaining the level of healthcare. Continuation of patient, whether it is by the same healthcare professional or not, is the purpose to which record keeping can contribute. The importance of the record was emphasized as health-care provision by allied professionals became common.

The information processing system for patient records should be measured using many basic indicators. It should 1) be re-readable, 2) provide prompt display, 3) assure no records can be lost, 4) be easy to use. Without guaranteeing these basics, any added feature systems, such as electronic patient records, are "Trying to walk, before being able to stand". Users are accustomed to the performance of the latest IT systems, high speed CPUs and networks. Handling health information cannot be an excuse, no matter how enormous the amount of information is.

Plus, as advanced indicators, information processing systems of patient records should 5) present information for future users, 6) provide useful search mechanisms, 7) allow access to multiple users in remote locations, and, 8) provide enough security. We have been working hard on this issue, through health information system research, for decades.

2. What more can we expect?

With the above mentioned functions, we have, and can handle, much more health information than ever. These are cumulative laboratory test results from automated analyzers, slices of images from many modalities, long history of prescriptions ordered, etc. Decades ago, many applied artificial intelligence systems[1] were built requiring exhausting data input. We can now import automatically, thanks to the standardization of healthcare data exchange. What can we now expect from patient records, in addition to the basic role of well-kept patient records?

a. Contribution to progress of medical science

For medical science, the size of trials is of primary importance. More power is added by the massive amounts of data collected by statistical or any other retrospective analysis method. Automated methods can even be applied to create hypotheses. Methods used for this purpose include data mining and intelligent information retrieval.

b. Optimization of patient care

The fruits of medical science are to be applied to patient care. The high percentage of patient data, handled by information systems, improves the precision of its application. The more patient data that is acquired at real time, the better planned care can be checked automatically, and the better the timeliness of decision making.

Due to networks, the source of the application can be located remotely. This means, the patient, attending professional, and information system do not have to be in the same place at the same time.

c. Improvement of management by the healthcare provider

Eliminating multiple data input and other unnecessary paperwork (whether on paper or not) dramatically improves the efficiency of the health-care professional's work. Recognition of hand-written prescription orders is not the professional work to be done by pharmacy professionals.

Moreover, outcome analyses of healthcare provider performance yields many valuable ideas for improvement.

3. Barriers

Electronic patient record (EPR) systems are now being developed in many places, in many ways. Yes, we now have plenty of data. CPUs and networks are amazingly fast and inexpensive. Under these circum-stances, it seems like most of the problems that have been carried over are to be solved by the EPR systems.

In 1996, Kameda General Hospital in Awa-Kamogawa, Japan, launched a hospital-wide EPR system. Its user interface is based on 2-dimensional clinical pathway. This case provided us with many lessons. Clinical pathways performed like guidelines and are proven beneficial for less-experienced physicians, acting as check lists. The user interface, used by the professionals for inputting signs and symptoms, was not fluent enough. Above all, it proved that unless data codes, like diagnosis, were standardized, outcome studies cannot be sufficient, especially if analysis is done by comparison with other hospitals.

Let us take another viewpoint. To enjoy the scale merit of available data from many sub-systems and other healthcare providers' information systems, there must be mutual understanding and migration of each data. To transmit any intelligent observations, ideas, decisions, two things must be mutually understandable: the model representing basic structures of the subjects, and the terminology to be used on the model. The latter is now being improved by many efforts to standardize terminology and codes. The difficult part, however, is yet to come. The achievement of the former, where object-oriented methods are promising, is slower than the latter, and is much slower than IT evolution. We see the same old fundamental wisdom now and again: information systems cannot use knowledge that has not been taught and cannot process data that has not been input.

Given the limited materials for successful construction of EPR, we cannot expect all problems can be solved by it. [2] Then, we have to limit our speculations. We have to clarify the purposes of the EPR installation and check feasibility of each. In 2000, Shimane Central Prefectural Hospital in Izumo Japan launched hospital-wide, total-paperless, full order entry EPR. The purpose of this EPR project was not for the EPR itself, but for patient accommodation improvement and outcome studies. The EPR system showed technical improvements of network speed, better user interface, etc., which enabled this huge system to work in reality. Still, however, in areas of less standardization, outcome studies are not satisfactory.

Again we are now in a stage of discriminating between what has been conquered and what still requires efforts, some of which has been described in the papers selected for this section.

4. In this section

Six outstanding papers were selected for this section. The first two papers show new methods that contribute to the benefits mentioned above, while the following four papers denote barriers.

a. Data mining

Brosette, et. al. [3] applied novel data mining techniques to hospital laboratory data of cultures of nosocomial infection germs and resistance of antimicrobial agents. Decades ago, antibiotics selection for infections was a good application area of artificial intelligence systems [4][5]. The variety of antibiotics is large and new agents are being introduced everyday. One of the barriers the old applied artificial intelligence systems was the effort of importing lab results. Now, we have them in standardized form. Another barrier was limited understanding and implementation of underlying domain knowledge.

Now, circumstances of this domain must be noted more. The high price of antibiotic medication is targeted. Multi-drug resistant infections, like that by MRSA, VRE, etc., became popular. A colleague antibiotic medication specialist, who taught me to implement domain knowledge, repeatedly predicted and warned about this situation in the late 80's, looking at all the abuse of wide-spectrum antibiotics. He hoped that applied artificial intelligence systems might decrease unnecessary prescriptions. We may or may not have enough time left, but this new technique of data mining, applied to cumulative lab data, will definitely contribute to an improvement of this situation.

b. Information retrieval by semantic terminological models

Brown et al. [6] showed the definite relative effectiveness of semantic terminological models for use in information retrieval of clinical findings. In this paper, the compared methods are: free text retrieval, ICD-10 retrieval, hierarchic retrieval. The last one is based on Read-code.

The semantic terminological method used is to prepare attributes for each concept. For example, "Ectopic pregnancy" is a "pathological process" in "site" of "intrauterine conception structure", "morphology" is "malposition", while "function" is "pregnancy". Obviously, this method is multi-axial, like SNOMED [7], while the ICD and Read-code based methods are single-axial. The advantage is remarkable.

The point is how to control the definition of each attributes [8], which could be solved by using a controlled vocabulary.

c. Concept indexing by UMLS

Nadkarni et al. [9] evaluated the feasibility of concept indexing to medical narrative text using UMLS [10]. It showed 82.6% were true positive matches. Causes of errors are redundant concepts in UMLS, homonyms, acronyms, abbreviations and elisions, concepts missing from UMLS, etc. The authors say that this rate is too low for this method to be used alone.

It has been reported that indexing with words is superior to indexing phrases in a controlled vocabulary. This may not be a perpetual result, as UMLS will be improved in future versions. The authors suggested future improvement directions in their paper. The authors also state that an approach, for example, that combines UMLS concepts with word-indexing will be encouraging.

d. Diagnostic coding tools

Nilsson, et., al. [11] evaluated three versions of Swedish ICD-10 coding tools for primary care: the official book version, a computerized version with the traditional ICD structure, a computerized version with a newly suggested compositional structure.

The paper notes that the viewpoint of primary care is somewhat different with a traditional ICD structure. This motivated the creation of the compositional structure tailored to primary care.

The result showed that all three are almost identical in reliability at code level, while reliability of diagnostic code aggregation was improved by the new compositional structure.

e. Patients with or without their own record

It seems that when patients hold their own healthcare records, see, and show them to their current attending physicians, this results in better care, improved communication, and promotes patient involvement. In obstetric and pediatric care, it was true. Drury et al. tried this for cancer care. [12]

The result is surprising. Supplementary patient-held records for radiotherapy outpatients appeared to have no effect (better or worse) on satisfaction in regard to communication, participation in care, or quality of life.

This report implies many lessons. We call "hospitals for patients", while "patients" are of many kinds. Improvement of the availability of information is not a goal, just a method.

f. EPR and its discontents

In the last paper of this section, Goorman et al. claim the reason why current EPRs frequently show problems in practice is that they are based on models that often contain projections of nurses' and doctors' work as it should be performed on the ward, rather than depicting how work is actually performed. [13]

This is not only the case for EPR, but also for the order entry system. In Japan, order entry systems are very common. 42% of the hospitals with more than 500 beds have order entry systems. Lessons learned from Japan's situation is, to make matters worse, "the discontents" are different among hospitals. This paper helpfully suggests many proposals to improve this chaotic circumstance.

5. Final remarks: preparating for an unpredictable future

About two decades ago, the introduction of MRI was a smashing hit. It seemed like MRI can image anything invisible by X-CT. Taking X-ray radiation doses into account, it seemed that no X-CT may survive. Now, we have both and good indications for each. We must clearly know what we can expect from the EPR and what we cannot.

Hospital managers want "good data" every time, regardless of the source, from information system or not. Medical informatics professionals predict as far as their imagination reaches. Yet, we cannot predict all of the future. We cannot create a universal model. The least we can do is to prepare healthcare information systems to yield data in an intelligent and standardized way, and prepare good documents to provide a good working environment to future users.

References

1. Fieschi M. Knowledge Processing and Decision Support Systems. Synopsis. 2001 IMIA Yearbook of Medical Informatics. p. 487-9.
2. McDonald CJ. The barriers to electronic medical record systems and how to overcome them. J Am Med Inform Assoc 1997;4:213-21.
3. Brossette SE, Sprague AP, Jones WT, Moser SA. A Data Mining System for Infection Control Surveillance, Method Inform Med 2000;39:303-10.
4. Shortliffe, E H. Computer-Based Medical Consultations: MYCIN, North-Holland; 1976.
5. Kimura, M, et al. Cross-Hierarchy Representation of Medical Knowledge – As Applied in Antibiotic Medication Counseling and Side Effect Information. Proc. of SCAMC;1987. p.207-12.
6. Brown PJB, Sonksen P. Evaluation of the Quality of Information Retrieval of Clinical Findings from a Computerized Patient Database Using a Semantic Terminological Model. J Am Med Inform Assoc 2000;7:392-403.
7. The Systematized Nomenclature of Human and Veterinary Medicine: SNOMED International. College of American Pathologists; 1993.
8. Rector AL. Clinical Terminology: Why is it so Hard? Method Inform Med 1999;38 (4-5):239-52.
9. Nadkarni P, Chen R, Brandt C. UMLS Concept Indexing for Production Databases: A Feasibility Study. J Am Med Inform Assoc 2001;8:80-91.
10. National Library of Medicine, UMLS Knowledge Sources, 9th ed. Bethesda, MD; 1999.
11. Drury M, Yudkin P, Harcourt J, Fitzpatrick R, Jones L, Alcock C, et al. Patients with cancer holding their own records: a randomized controlled trial. British J Gen Practice 2000;50:105-10.
12. Goorman E, Berg M. Modelling nursing activities: electronic patient records and their discontents. Nursing Inquiry 2000;7:3-9.
13. Nilsson G, Petersson H, Ahlfeldt H, Strender L-E. Evaluation of Three Swedish ICD-10 Primary Care Versions: Reliability and ease of Use in Diagnostic Coding. Method Inform Med 2000;39:325-31.

Address of the author;
Michio Kimura
Professor and Director
Medical Informatics Department
Hamamatsu University, School of Medicine
1-20-1 Handayama
Hamamatsu, 431-3192, Japan
E-mail: kimura@mi.hama-med.ac.jp