The use of an electronic medical system in a pediatric emergency department with a clinical score triage system

Utilização de um sistema informatizado de atendimento em pronto-socorro pediátrico com sistema de escore clínico de triagem

Maria Beatriz de Moliterno Perondi¹, Tânia Miyuki Shimoda Sakano², Cláudio Schvartsman³

ABSTRACT
Objective: To describe the implementation of an electronic medical health care system in a tertiary pediatric emergency department by means of reporting some care indicators before and after implementation. Methods: A descriptive, retrospective study describing the implementation strategy of an electronic medical record system was conducted at the Emergency Department of the Instituto da Criança of the Faculdade de Medicina da Universidade de São Paulo. The system was assessed during the period between January 1st, 2005 and June 30th, 2006, after the implementation of the electronic medical record system, and the indicators took into consideration were number of patients seen (89,429) and distribution according to the clinical score, hospital stay, amount of mislaid or lost medical records, number of drop outs, waiting time for medical consultation and percentage of patients discharged home according to the score. Health care indicators such as waiting time, percentage of mislaid or lost medical records and patient drops out were compared between March 2005 and March 2000 – the period prior to implementation of the electronic medical record. Results: During the period prior to the implementation of the electronic medical record, the average time spent at the hospital was four hours and seven minutes, 5.1% of medical records were mislaid or lost, and 4.8% of patients seen were admitted to the hospital. During the post-implementation period, the average time spent at hospital was two hours and three minutes, no medical records were mislaid or lost, and 6% of patients seen were admitted to the hospital. Conclusions: The use of an electronic medical record improved patient flow, medical records were more complete and increased team satisfaction.

Keywords: Medical records systems, computerized; Emergency medical services/organization & administration; Triage/statistics & numerical data

RESUMO
Objetivo: Descrever a implementação do atendimento eletrônico em um pronto-socorro pediátrico terciário, relatando alguns indicadores de atendimento antes e depois da implantação. Métodos: Estudo retrospectivo descritivo realizado no pronto-socorro do Instituto da Criança do Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo relatando a estratégia da implementação do sistema eletrônico. Foi avaliado o período entre 1º de janeiro de 2005 e 30 de junho de 2006, posterior à implantação do sistema eletrônico, levantando os seguintes indicadores: número de pacientes atendidos (89.429) e distribuição de acordo com escore clínico, tempo de permanência hospitalar, quantidade de fichas extraviadas, número de evasões, tempo de espera para consulta e porcentagem de alta domiciliar de acordo com escore. Indicadores como tempo de espera, percentual de fichas extraviadas e evasões foram comparados entre março de 2005 e o período anterior à instalação do prontuário eletrônico em março de 2000. Resultados: No período anterior à implantação do prontuário eletrônico, o tempo médio de permanência foi de quatro horas e sete minutos, houve extravio de 5,1% das fichas e foram internados 4,8% dos pacientes atendidos. No período após a implantação, o tempo médio de permanência foi de duas horas e três minutos, não houve extravio de fichas e 6% dos pacientes atendidos foram internados. Conclusões: O uso do prontuário eletrônico permitiu a agilização do fluxo de pacientes, melhoria no preenchimento do prontuário e satisfação da equipe.

Descritores: Sistemas computadorizados de registros médicos; Serviços médicos de emergência/organização & administração; Triagem/estatísticas & dados numéricos

Study carried out at Emergency Department of the Instituto da Criança of the Faculdade de Medicina da Universidade de São Paulo – USP, São Paulo (SP), Brazil.

¹ Pediatrician and Sports Physician at the Hospital Israelita Albert Einstein – HIAE, São Paulo (SP), Brazil.
² Master’s degree, Attending physician at the Emergency Department of the Instituto da Criança of the Hospital das Clínicas of the Faculdade de Medicina da Universidade de São Paulo – USP, São Paulo (SP), Brazil.
³ PhD, Head of the Emergency Department of the Instituto da Criança of the Hospital das Clínicas of the Faculdade de Medicina da Universidade de São Paulo – USP; Clinical director of the Hospital Israelita Albert Einstein – HIAE, São Paulo (SP), Brazil.

Corresponding author: Maria Beatriz de Moliterno Perondi – Rua Presidente Antonio Cândido, 350 – apto. 32 – Alto da Lapa – CEP 05083-060 – São Paulo (SP), Brazil – Tel: 11 3836-7681 – e-mail: biap@uol.com.br

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INTRODUCTION
Managing an emergency department (ED) is an extremely difficult task. Its routine includes several variables, and, frequently, the staff on duty faces chaotic situations, working stretched to the limit. Everyday, there are huge lines, with extremely long waiting times, and patients and companions become worried, annoyed and tired. Some of these patients are not severely ill and could be seen at outpatient’s clinics, whereas others, who really need immediate medical care, have to wait too long. Emergency care, delays in requesting and performing exams and receiving drugs, moving teams around to transport patients and the large amount of paperwork to fill out make the staff work difficult, leaving less time to be with the patients themselves. Drop out rates are good indicators to assess overcrowding of emergency room units, and, in the United States, they range from 2 to 7% \(^{(1)}\). At the ED of the Instituto da Criança at Hospital das Clínicas of the Faculdade de Medicina da Universidade de São Paulo (ICr/HC-FMUSP), this rate varied from 1.66 to 8.32%, in 2005.

Another concern is data register: many medical records are either mislaid, or not completely filled out by the medical or nursing staff. The ED medical record leads to many setbacks, such as records incorrectly filled out, difficult storage of records, illegible hand writing, illegible signature, mislaying, time spent to fill them out and cost of the material, among others \(^{(1-3)}\).

Despite the multiple factors interfering in the ED operation, one of the attempts to improve service flow and, consequently, quality of healthcare delivered to patients is the electronic medical health care system, in which, from entry registration to patient discharge, all records are electronically filled in \(^{(4-5)}\). Through this method, several problems are solved, such as records incorrectly filled out, difficult storage of records, illegible hand writing, illegible signature, mislaying, time spent to fill them out and cost of the material, among others \(^{(1-3)}\).

OBJECTIVE
The objective of this study was to describe the electronic medical health care system implemented at the ED at ICr/HC-FMUSP and the preparation and implementation strategy, as well as to describe a number of health care indicators from periods before and after implementation.

METHODS
Infrastructure and implementation strategy
Meetings with ED physicians and the Information Technology team from the ICr/HC-FMUSP were held during a one-year period (September 2001 to October 2002) to establish goals and criteria to create an electronic medical record according to the needs of the service.

Since the project demanded high performance in storing and recovering data, a 2.4-Ghz four-processor server was used. The files were stored in a storage area network (SAN) unit. An increased network flow was anticipated and could lead to strangled server access; therefore, all data cabling in the ED area was restructured to meet the new specifications. Each office was equipped with a computer, totaling up ten machines. A laser printer and two electronic panels to call patients were also installed. A relational database was used for data storing and retrieval, with cryptography algorithm to ensure access security. The programming language used was Microsoft Visual Basic version 6 \(^{6}\).

During the first phase, the work was to set up the triage system, establishing clinical criteria and creating a database to feed the first screen. The physicians were able to participate in the pilot plan in order to test efficiency of the method. After starting the electronic triage operation, the team prepared the electronic medical record, developing a full, precise and user-friendly model, which was tested by ED resident and attending physicians. The information technology team was on remote call in case of problems, failures or any modifications required in the system. The third step in the electronic medical record implementation was to insert two more items in the system: prescription of some drugs, which were selected by the physicians responsible for the project, according to frequency of use in the service, and a field where specialists, neurologists and surgeons could write their evaluations, after receiving training on how to insert electronic notes in the medical records. Lastly, some months after initiating the electronic triage, the electronic medical record was concluded, receiving the addition of electronic request for laboratory and imaging tests. Once again, the physicians responsible for the project chose the main exams that would be made available in the system.

The period evaluated went from January 1st, 2005 to June 30, 2006, based on the following information:
number of patients who received medical care and their distribution according to clinical score, length of hospital stay, amount of medical records mislaid, number of drop outs, waiting time for medical consultation and percentage of patients discharged according to clinical score. In order to compare waiting time for medical consultation, percentage of mislaid medical records, and percentage of dropped out patients, a 30-day period before setting of the electronic medical record, from March 1st to 31, 2000, was evaluated, as well as after its implementation, from March 1st to 31, 2005.

**System description and implementation**

In the period prior to automation, the ED operated with the patient’s registration entered by administrative staff, which generated a medical record that was later manually filled out by physicians. Patients were sent by the front desk to the triage area, where a physician conducted a subjective evaluation to decide if the patient was “well” and could wait in line, if the individual should be seen before others, or if he/she would be referred to a different service (Primary Healthcare Unit, Orthopedics, Otorhinolaryngology, Ophthalmology etc.). Patients sent to the emergency room line had their records put in a box, and were called by the doctor in order of arrival. Requests for exams, drugs, or referrals were written on specific forms.

With the implementation of the electronic medical system, after being registered at the front desk, patients waited to be called through an electronic panel using the number they were given; the panel was operated by the triage physician who first saw the patients, using a specific computer screen for patient’s initial assessment. This screen contained a questionnaire with 12 topics, and several previously registered answer options (Chart 1). The topics, defined by the medical staff, determined the patient score (from 0 to 39 points), and included inquiry and observations made by the physician. At the end of the triage, patients received a severity clinical score defining the priority in medical care. This score had different colors: white (0 to 3), green (4 to 8), yellow (9 to 14), orange (15 to 18) and red (19 to 39) – in that, the higher the score, the more severe the patient. According to the clinical score, patients were referred to the emergency room or another service, as required.

When sent to the emergency room, patients moved to the next step, in which priority of medical care was established according to the colors (clinical score), that was to say, severity. Following this order, first red received medical care, followed by orange, yellow, green and white scores. During consultation, pediatricians filled out the electronic medical record, organized into history of present illness, investigation on several systems, physical examination (general, skin, cephalic segment, neurological, respiratory, cardiocirculatory, gastrointestinal, genitourinary and pain assessment), allergies, comorbidities, drugs on use and prior hospitalization. Some items were mandatory to fill in and physicians could not carry on if they did not complete them.

After the first consultation, patient could be referred to medications, laboratory or radiology tests, specialists or social workers, hospitalization or be discharged. If a patient had to wait for tests, specialists, or to receive medication, a new screen was opened, remaining open until the patient was re-evaluated. All drugs were prescribed electronically, and appeared on the screen located at the medication room for the Nursing staff. Care provided in this room was also prioritized by color code. The drugs were checked electronically, enabling lot/batch tracking. An electronic authentication was required.
for any access to electronic medical records, in order to verify the professional access privileges, and it worked as an electronic signature in case of drug prescriptions. Upon discharge, it was mandatory to fill in the diagnoses using the International Statistical Classification of Diseases and Related Health Problems version 10 (ICD-10). Once medical care was concluded and electronically authenticated, the medical record no longer allowed further changes.

The system also generated spreadsheets that enabled any team member to immediately visualize the waiting lines existing in triage, emergency care and observation areas, and patients were always identified according to severity color code. It also provided alarms whenever an electronic medical record was not used for more than four hours and sent a warning signal when test results were available.

**RESULTS**

**Healthcare indicators**

From January 2005 to June 2006, a total of 89,429 patients received medical care; no medical record was mislaid, since they were not printed, nor filled out incompletely. The distribution of these 89,429 patients and the percentage of patients discharged from the ED, according to the clinical score, are displayed in Figures 1 and 2. The number of patients with white and green scores (no urgency) accounts for 96.8% of appointments. Based on clinical score, the mean time between triage and consultation in the ED is shown in Figure 3. The clinical score enabled a marked reduction in waiting time (Figure 3) for the most severe patients to receive medical care (69 minutes for white-coded patients to 26 minutes for orange-coded patients), and also demonstrates an expressive difference in the percentage of discharge between more and less severe scores (Figure 2).

In March 2005, a total of 5,044 patients received medical care; out of these, 1,646 (30%) had already been at the ED in the previous six months, and, of those, 329 (6%) had been hospitalized during the period. From the total number of patients seen in March 2005, 2,200 were seen for the first time and 2,844 had already received medical care at the ICr; 15.92% were followed up at outpatient clinic of this service. The mean time at the ED was two hours and three minutes. The drop out rate in this period was 185 (3.67%).

In March 2000, 4,420 patients received medical care, and 227 medical records were mislaid (5.1%). From the total number of patients seen during this period, 213 (4.8%) were hospitalized. The mean time at the ED was four hours and seven minutes. The drop out rate added to the number of mislaid and canceled medical records total up 345 patients (7.8%).

![Figure 1. Distribution (%) of care delivered according to clinical score](image1.jpg)

![Figure 2. Percentage discharge rate from the emergency department and clinical score](image2.jpg)

![Figure 3. Mean time for consultation at the emergency department, in minutes](image3.jpg)
DISCUSSION

As described in the literature, the use of electronic medical records at ED brings many advantages to all medical, Nursing and administrative staff. Physicians can dedicate more time to patients, since there are less printed forms to fill out, such as requests for exams and specialist referrals\(^{10}\). Furthermore, with electronic medical record, chances for medical error decrease\(^{6}\), services are better managed and an overall view of the situation is provided. At the ED of the ICr/HC-FMUSP, by verifying the waiting line and observation screens, it is possible to know how many patients are waiting to be seen, how many are being seen, their severity, the time each patient has been waiting, and how many are waiting for specialists or for exams and medication. When test results are available, the screen displays a warning signal, likewise when a drug is administered. Some studies, including one conducted by Likourezos\(^{3}\), report physician and nurse satisfaction with the use of electronic medical records, and their main compliment is speeding up patient’s flow. For medical and Nursing staff, the electronic medical record can also help minimizing errors regarding drug administration\(^{6-8}\).

It is no longer necessary to store paper forms, it is easier to perform billing and the entire patient registration process is easier, from arrival to discharge or hospitalization. According to Wang et al.\(^{9}\), implementing an electronic system results in financial return for the institution, since the initial investment with equipment, implementation, support and maintenance is soon made up by savings achieved by not printing forms, correctly using drugs and more accurate billing, among others.

Improving quality of healthcare delivered to patients is probably the main advantage of electronic systems. Both the literature\(^{1-2}\) and this study show that the drop out rate, waiting time for consultation and time spent at the ED were reduced. Another advantage was access to previous medical records of patients, which is especially important, since approximately 50% of them have multiple appointments. These data show enhanced efficacy and expediting of the service, providing better quality and safety for patients.

The main barriers to implement the electronic system are financial and technical issues. Some studies\(^{11-12}\) carried out in the United States showed that, during 2001 and 2003, only 31% of emergency services used electronic medical record. In Brazil, very few hospitals have sophisticated information systems and information technology staffs capable of supporting an electronic medical record in the ED, integrating several hospital units and operating 24 hours per day.

The analysis of patient distribution according to the clinical score clearly shows the difficulty in introducing a tertiary ED, such as the ED at the ICr/HC-FMUSP, in a health care system in which patient care hierarchy is not well established in the city of São Paulo. Most care is provided to white and green score patients (no urgency), overburdening the service and jeopardizing the care of patients whose clinical conditions require treatment at a tertiary care unit. These data show the need to expand outpatient’s and inpatient’s network at primary and secondary care levels.

The clinical score led to a marked reduction in the waiting time for consultation of more severe patients. Although it is an original contribution and has proven to be very useful to manage ED actions, this score has been basically used to give priority to some patients. There is an ongoing validation process of its use, establishing specificity and sensitivity of its results and differentiating each item. Its results will indicate improvements to be made, which may even enable making decision about patient’s referral after triage.

CONCLUSIONS

The use of electronic medical records is very helpful, as shown by enhanced efficacy, better quality of care delivered and more agile patient flow, increasing safety, savings and team satisfaction.

REFERENCES


