International Journal of Clinical Monitoring and Computing **12:** 37–41, 1995.

Data processing in prehospital emergency medicine

Peter Felleiter, Matthias Helm, Lorenz Lampl & Karl Heinz Bock
Dept. of Anaesthesiology and Intensive Care Medicine, Federal Armed Forces Medical Center, 89070 Ulm, Germany

Accepted 8 December 1994

Key words: data processing, computers, emergency medical services, Medical Information Bus (MIB), monitoring

Abstract

Information about the use of data processing systems in prehospital emergency medicine were collected, using a questionnaire sent to all German rescue helicopter bases. Twenty-seven of the 42 German rescue helicopter bases returned the questionnaire. At present, only 15 of them take advantage of electronic data processing. All of them enter their data manually by keyboard, automatic data transfer by means of a bar code reader is available at one base only. The stored data are used for statistical analysis (n = 15), quality assessment (n = 10), administration (n = 10), research (n = 9) and education (n = 7). Based on the data of this survey, one fifth of those who replied use their computer only for administrative purposes, the other also manage patient and mission data with their computer systems.

Today, documentation of a rescue mission consists of patient data, vital data, mission data and information about the procedures carried out. The use of a computer system, however, requires more time and work than a handwritten record, when most of the data have to be entered manually using a keyboard. Future developments may include automated data transfer and digitization of handwritten documents to decrease the workload of the staff. For the automation of data transfer, configuration and synchronisation a standardized interface in all medical devices is required. There is a clear need for the use of data processing systems in emergency medicine.

Introduction

Only a short period of time is available for the emergency physician to diagnose and treat his patient. After transportation to a hospital not only an oral report but also a detailed written protocol is necessary to document the patient's history, symptoms, vital parameters and treatment for his medical record. Prepared under adverse circumstances (e.g. in moving vehicles) these hand-written protocols and particularly their copies are often hardly legible [2, 3].

Medical computing is used frequently for data processing in anaesthesiology and intensive care medicine [4, 5]. Tasks typically done best with electronic data processing devices are collection and storage of all measured data, fitting these data into the correct time frame, combining them with additional information and legible presentation of these data on a screen and as a print-out.

During the prehospital emergency treatment, monitoring devices continuously measure vital parameters and collect these data. It is desirable to have the acquired data available for information during and documentation after the mission. Many of the presently available medical devices have been designed for collection and storage of data, but both abilities are often limited by inadequate memory and battery capacities. Vital data stored in medical devices are only a small part of the information that has to be worked with during and after an emergency mission (Table 1). A large number of patient and mission data accompany the patient from his first contact with the emergency team until his discharge from the hospital [1, 2].

The aim of our investigation was to know how intense the use of computing in emergency medicine already is, how the data are entered into the system and what the data are used for.

Table 1. Relevant information that may be entered into a data processing system.

Input	Chip card	Medical device	Notepad	Computer-system
– Patient data				
Name	*			
Date of birth	*			
Address	*			
Employer	*			
Health insurance	*			
– Vital data				
Medical history	*			
Clinical findings			*	
Monitoring (ECG, SaO2, temp., NIBP)		*		
First diagnosis			*	
– Therapy				
Measures			*	
Drugs			*	
Devices (ventilator, defibrillator, pacemaker)		*		
– Mission data				
Mission number				*
Date/time				*
Location			*	
Personnel			*	
Additional data sources				
- Data bases				
Intoxication				
Dangerous goods				
Drug information				
Maps				

* indicates the possibility for automatic data entry.

Methods

In January 1993 a questionnaire was sent to all forty-two German rescue-helicopter bases. In this questionnaire we asked for information about the use of computers in emergency medicine:

1. Is an electronic data processing system available for collection and/or documentation of patient data or mission data?
2. Which devices are used for the data input?
3. What are the data used for?

We gave examples for all questions, multiple answers were possible. After six weeks we sent another copy of the questionnaire to those bases that had not yet answered.

Results

Twenty-seven of the forty-two rescue helicopter bases did return their questionnaires.

Use of electronic data processing

At fifteen of these helicopter bases a computer system is used in some way for collection and/or documentation of data. All bases that possess a computer system use it for storage of mission data, at twelve of them the patient data are also stored and processed on a computer.

Data acquisition

One of the helicopter bases which answered uses a bar code reader as an automatic input device. Manual input by a keyboard is the only available input system

used by all other computer users (n = 14). Data transfer from monitoring devices to a computer system or from portable computing systems to a stationary system is not used.

Data use

The most common use of data stored on a computer is statistical analysis, all bases use their data for this purpose. Quality control is also a frequently named use (n = 10), followed by research (n = 9). Less than half of the bases (n = 7) use the collected data material also for educational purposes.

Table 2. Possible use of data files.

Output
– Documentation
Emergency protocol
– Administration
Billing
Statistics
Stock control
– Research
Pro- and retrospective studies
Statistics
– Education
Analysis
Training
Case studies
– Quality assessment
Internal quality control
External quality control

Discussion

Current practice

Data acquisiton

Electronic data processing systems promise to be helpful for the work with both mission and patient data during emergency treatment and patient transport. However, only a little more than half of the helicopter bases use a computer. Most of these bases use their computer only for statistical and administrative purposes, only few bases also manage patient data files with their computer system. One of the main problems of automatic data processing systems is the fact that all data have to be available in a specific digitized format, before any use of the system is possible. Therefore all data have to be entered into the system either manually (using e.g. keyboard, mouse, lightpen or notepad) or automatically (using e.g. scanner, bar code reader or chip card). Until now, all helicopter bases use a keyboard for manual data input, but only in one single case data are also entered automatically by means of a bar code reader.

Data use

All data collected during the emergency treatment of a patient can be summarized in a joint data file. Although the potential use of such data is manifold (Table 2), most of the helicopter bases use their computerized records only for statistical analysis. Growing expenses for the health care system force the justification of every measure in preclinical emergency treatment. Statistical analysis of every medical procedure performed is an important measure for the determination of equipment and staff requirements. Complete documentation and proper statistics about all missions are indispensable to support budget claims for material and personnel with facts.

One of the most popular fields of computer use is research, in one third of all the bases which answered a computer was used for scientific purposes. This relatively high portion can partly be explained by the fact that most rescue missions in Germany are physician-accompanied, therefore stimulating a great interest for publications on the field of emergency medicine.

Up to now only two thirds of all helicopter bases which answered use a computer for quality control. Measures of internal and external quality assessment and quality control, however, are important purposes for the use of electronic data files. In emergency medicine first experiences with the use of an audit system seem to confirm the applicability of quality control as a way to quality improvement [9, 10]. Laws and regulations will increasingly force all providers of medical services to prove their standard of quality by participating in quality control measures. Subsequently the necessity to present adequate data will arise, a task that is enormously facilitated by electronic data processing systems [11, 12].

Future developments

Data acquisition

In emergency medicine vital functions are monitored with mobile equipment. Measured data are routinely read from the instrument's screen and written on the protocol by hand. Many of the currently used monitors can store measured data for a period of several hours, making it possible to show or print out tables or graphs after the end of a mission. Loss of energy supply, resulting e.g. from low battery voltage or disconnection from other energy sources, is usually followed by the loss of stored data. For data transfer a standardized interface is needed, built in every medical device for anaesthesiology, intensive care and emergency medicine. The Medical Information Bus (MIB), under development by the Institute of Electrical and Electronic Engineers (IEEE), will be such a standard [7, 8]. This standard family uses international standards for open systems communication, key requirements are automated configuration of networks, simple user interfaces and unambiguous association of a device with a specific patient or bed. After acceptance of standards for medical device communications every medical device will have a built-in device communications controller (DCC). This DCC interfaces between the medical device and the bedside communications controller (BCC), which is the connection point to a patient care systems.

In emergency medicine, automated interfacing will enable us to combine collected monitoring data and other information about the patient. Availability of patient data cards, containing important information like chronic diseases, drugs or allergies, would enable the physician to treat unknown and unconscious patients with more safety. Automated transfer of these data would be no problem. To avoid an increase in the staff's workload, as much information as possible should be entered into the computer system automatically. Only if the physicians and paramedics are still able to concentrate on the treatment of the emergency patient, will it be possible to establish computer systems in the field of preclinical medicine.

Emergency patients are new patients, in prehospital care there is usually no pool of stored data that can be of help for the physician. The amount of information about the patient's history, acute status and treatment increases every minute after the rescue team starts to work. This makes it necessary to write down all data for patient identification, treatment documentation, as well as administrative purposes. Up to now, this document is a handwritten form, containing a more or less standardized data set. For Germany a standardized emergency protocol was defined in 1992 and is being tested since then [6]. It contains a minimal data set for emergency medicine including a quality assessment system and is designed for manual data input into a computer system after mission completion. This manual data input using a keyboard increases the workload for the emergency staff, whereas the use of a notepad for the transfer from handwritten into digital information during the mission would not influence the amount of documentation work.

All data documented during the prehospital treatment are of high importance for the hospital receiving the patient. Data transfer by interfacing a mobile computer system with the stationary computer system of a hospital avoids the necessity to write down the same thing several times. The information received can be printed out immediately in a well legible form, without delay or danger of misreading handwritten protocols. Transmission of these data to the emergency department of a hospital before the time of arrival would enable immediate continuity of treatment and save a lot of time [1].

Data use

Up to now, real time documentation of rescue missions has only been possible using voice recorders or video tapes. Retrospective estimation of time intervals for diagnostic or therapeutic interventions is extremely inaccurate. Data files combining manually entered data with monitoring data stored during the prehospital phase would make it possible for the first time to train rescue teams by repeating actual missions in a real time mode. This would also enable a completely new access to quality assessment methods [1].

Conclusion

Acceptance of data processing units requires the maturity of these systems to decrease the workload of the staff. This will only be possible, when data can be entered handwritten by means of a notepad and/or automatically by a card or bar code reader. Emergency medicine will always necessitate the use of mobile and modular components. Only the use of standardized interfaces with the option of a retrospective system-time synchronisation will enable data transfer from

monitoring devices to portable or stationary computer systems. This will improve the documentation of a rescue mission, with immediate delivery of legible records and exact monitoring data and the respective times. A comprehensive use of the patient files for administration, quality assessment, research and education will then be the result.

References

1. Aghababian RV, Williams KA, Holbrook JA, Lew R. Computer applications in quality assurance. Emerg Med Clin North Am 1992; 10: 627–47.
2. Eichhorn JH. Anesthesia record keeping. Int J Clin Monit Comput 1993; 10: 109–15.
3. Holbrook JA, Aghababian R. A computerized audit of 15,009 emergency department records. Ann Emerg Med 1990; 19: 139–44.
4. Abenstein JP, DeVos CB, Abel MD, Tarhan S. Eight years experience with automated anesthesia record keeping: Lessons learned – new directions taken. Int J Clin Monit Comput 1992; 9: 117–29.
5. Gardner RM, Huff SM. Computers in the icu: Why? What? and so what? Int J Clin Monit Comput 1992; 9: 199–205.
6. Herden HN, Moecke H. Bundeseinheitliches Notarztprotokoll. Notarzt 1992; 8: 42–5.
7. Wittenber J, Shabot MM. The medical device data language for the P1073 medical information bus standard. Int J Clin Monit Comput 1990; 7: 91–8.
8. P 1073 Standard for Medical Device Communications – Overview and Framework. IEEE; June 1994.
9. Felleiter P, Breschinski W, Lampl L, Bock KH. Quality assurance measures in the area of secondary transport. Part I: Fundamentals and methodological requirements. Anaesth Intensivmed 1994; 35: 73–7.
10. Felleiter P, Breschinski W, Lampl L, Bock KH. Measures for quality assurance in secondary transportation. Part II: Results of an investigation involving 204 patients. Anaesth Intensivmed 1994; 35: 106–9.
11. O'Leary DS, O'Leary MR. From quality assurance to quality improvement. Emerg Med Clin North Am 1992; 10: 477–92.
12. Williams RM. Public policy and quality assurance. Emerg Med Clin North Am 1992; 10: 493–506.

Address for correspondence: P. Felleiter, Dept. of Anaesthesiology and Intensive Care Medicine, Federal Armed Forces Medical Center, 89070 Ulm, Germany