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A study on hospital blood information systems

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ABSTRACT

The blood bank unit is one of the most important and fundamental units in every hospital especially in emergency situations. Lack of access to medical records related to individual's blood transfusion can postpone blood transfusion when it is essentially needed which can in turn increase patients' risks. Meanwhile, the role of a blood bank information system is crucial in accessing this information, thereby improving the quality of available care. This research was conducted to determine the status of the blood bank information system of the hospitals affiliated to Shahid Beheshti University of Medical Sciences.This descriptive- practical study investigated the blood bank information systems of 11 hospitals affiliated to Shahid Beheshti University of Medical Sciences in 2015. Data collection was performed through observation and interview, using a checklist and questionnaire. The validity of the instrument was determined through content validity and its reliability was confirmed through retesting. Data analysis was conducted using descriptive statistics.All blood bank information systems under investigation were semi-mechanized. It was impossible to send the full reports electronically and to present dynamic reports. The blood bank staff were not aware of the existence and significance of the relevant standards and no specific blood bank software were used.
Mechanized blood bank information systems bring about effective communication in various health care organizations. They lead to the application of relevant novel technologies while increasing patients' safety and satisfaction.

Key words: Blood bank information system; blood transfusion; blood bank; cross match; hospital

INTRODUCTION

Blood banks play a vital role in surgical and emergency interventions; therefore, they constitute an essential unit of the health care organizations [1]. A blood bank is where blood and blood products are stored. In addition, laboratory tests are conducted in blood banks in order to reduce the risks associated with blood transfusion [2]. Blood transfusion is an important therapeutic and supportive measure because it has made major [3] surgeries possible, made Obstetrics safer and reduced the death rate following major trauma. Rapid development of blood collection technology has provided the possibility of separating blood components, storage, diagnosing infection, and distributing blood products in blood bank systems [4]. Meanwhile, ensuring the absorption of a healthy donor is the first step in guaranteeing the security of blood transfusion services. Accordingly, the screening of donors based on only the general information obtainedfrom the medical record or their statements cannot be relied upon. Rather, more complete information about the results of

physical examinations, reactions after donation, and the results of laboratory tests is required. This is one of the challenges faced by many health care organizations. It is clear that a blood bank information system presents more objective and reliable medical information, thereby increasing the safety of the process of blood donation and transfusion [5]. An efficient blood bank information system helps judging the way services related to blood transfusion perform, tracking every donated blood unit from the onset, i.e. taking blood until the final stages, distribution, and investigation of the legal aspects [6]. On the other hand, today, information and computer technology is widely used in medicine and is capable of decreasing the workload and errors related to a blood bank [5]. The use of computer systems is essential, in order to improve the efficiency, accuracy, and effectiveness of blood transfusion services [6]. Indeed, blood bank information systems are computer systems developed to help blood bank experts manage information related to donor and patient, as well as the information related to blood products [7]. Therefore, the availability of an information system conformed to the need of users is crucial to diminish workload, minimize patients' waiting time to receive blood, prevent the replication of tests, reduce costs, and improve the quality of information presented to users, which will lead to improving the quality of services offered to clients. In addition, blood bank information systems play an important role in presenting the necessary information regarding the shortcomings, necessities, and requirements of blood bank units. The aim of this study was to investigate the status of blood bank information systems in teaching hospitals affiliated to Shahid Beheshti University of Medical Sciences. It contributed to identifying strong and weak points of these systems which in turn can be used in resolving the defects, improving, modifying, developing, and evaluating the blood bank information systems across other hospitals.

MATERIALS AND METHODS

This research is descriptive and was conducted cross-sectional in 2015. The research setting involved the blood bank of teaching hospitals affiliated to Shahid Beheshti University of Medical Sciences along with the library of medical sciences universities, hospitals, and the Internet. This study investigated the blood bank information systems of 11 hospitals affiliated to Shahid Beheshti University of Medical Sciences. In this study, all research units were studied and samples selection were not done. Data collection was carried out in the form of observation and interview, using a checklist and questionnaire. The validity of the checklist and questionnaire was determined through content validity, and retesting was used to determine the reliability of the questionnaire. Descriptive statistics were used to analyze the collected data.

RESULTS

The findings indicated that a mechanized information system does not exist in any of the blood bank sections of the investigated hospitals. Investigation of the information resources (registries and forms) in the blood bank section of the investigated hospitals revealed that blood and blood products request form, patients' reaction to blood and blood products injection report form, label of adaptability and cross match, wristband, and sample label are used in all these hospitals, among which only blood and blood products form is processed paper-based and electronically (available in HIS). All other processes are registered only manually. Data related to the blood bank information system were categorized into three groups of patients, blood products, and blood transfusion tests., the results of which indicated that both information elements are present in the system. Furthermore, all blood bank information systems under investigation had prepared monthly reports related to the consumed blood products whereas others were not prepared and presented in any of the studied systems (Table 1). Reporting in the blood bank information system is not completely performed electronically in any of the systems. The majority of them (72.7%) has conducted them manually via reporting forms (Table 2). In addition, the findings also indicated that barcode equipment, RFID, and software applications (except for HIS)

are used in none of the hospitals (Table 3). Across the studied hospitals, blood donors and Patients do not belong to the group of direct users of the blood bank information system (Table 4). In addition, there was no documented standard and instruction regarding the collection, processing, and distribution of information in blood bank information systems of these hospitals.

Table 1. Frequency distribution of various reports of the blood bank information system in the teaching hospitals affiliated to Shahid Beheshti University of Medical Sciences.

Row	Different reports of the blood bank information system	Percentage	Frequency
1	Monthly reports related to consumed products	100	11
2	reports related to the status of blood products	0	0
3	reports related to the hospital	0	0
4	reports related to match or mismatch of requests with the blood bank inventory	0	0
5	(New reports developed by the user (dynamic reports maker	0	0

Table 2. Frequency distribution of the way the reports of the blood bank information system of the teaching hospitals affiliated to Shahid Beheshti University of Medical Sciences are sent.

Row	Percentage	frequency	The procedure of transmission of blood bank information system reports	
1	72.7	8	Access to reporting forms	
2	27.3	3	Semi-mechanized	
3	27.3	3	By phone	Oral
	9.1	1	In person	
4	0	0	HIS	Electronic
	0	0	Email	
5	0	0	Administrative automation	

Table 3. Frequency distribution of the instruments along with hardware and software equipment used in the blood bank information system of hospitals affiliated to Shahid Beheshti University of Medical Sciences.

Percentage	frequency	Instruments as well as hardware and software equipment used in blood bank information system		Row
100	11		(Computer (hardware)	1
100	11	Software HIS	Computer (software)	2
0	0	Other software		
100	11		Network equipment	3
100	11		Reporting forms	4
100	11	Compatibility and cross match labels		5
100	11		Registries	6
100	11		Label on blood packets	7
0	0		Barcode	8
0	0		RFID	9
0	0		Electronic wristband	10

Table 4.Frequency distribution of users of the blood bank information system of hospitals

Percentage	frequency	The users of blood bank information system	Row
100	11	Physicians	1
100	11	manager of clinical laboratory	2
100	11	manager of blood bank	3
100	11	blood bank unit staff	4
100	11	Laboratory staff	5
100	11	Nurses	6
100	11	Financial and accounting sections	7
100	11	Medical record section	8
100	11	Hospital management (manager and head)	9
0	0	Blood donors	10
0	0	Patients	11

DISCUSSION

The blood bank information system contributes to rapid and accurate recovery of information, provision of service quality and safety, and the presentation of precise managerial information. Furthermore, it also allows access to statistical information to support effective clinical measures. The results of the study conducted by Caldanic and Vaquier indicated that in terms of demand for blood and blood products, computer information systems act as a guarantee for the security and confidentiality of blood transfusion in hospitals' blood banks [8]. The results of this study indicated that there is no mechanized blood bank information system in the hospitals under investigation. Considering the advantages of mechanized blood bank information systems including secure storage, rapid retrieval of information, accelerated conduct of blood bank activities, decreased human errors, preservation of the security and confidentiality of information, facilitation of information exchange between various units, and increased quality of patient care, it seems essential to convert blood bank information systems in hospitals to mechanized systems. With respect to the information elements available in blood bank information system, Clark et al stated that the data of the blood bank information system is divided into three groups related to patients, blood products, and blood transfusion tests. The data related to patients include the patient's record number, first name and surname, gender, age, place of birth, the blood group, name of the physician, the reason for the need to inject blood and blood products, the type of antibody, and the address of the patient. The data associated with blood products include the product type, the product code, expiration date, date of entry to the blood bank, as well as the blood group of the product. Finally, data related to blood transfusion tests include the blood group and Rh, blood compatibility tests, and cross match [9].

All the information elements mentioned above were similarly completed in the studied hospitals due to the application of similar forms and software systems with similar data elements. The maintenance and storage of this information can prevent replication of tests which may impose undue costs on the patient in addition to the presentation of more quality care within the shortest possible time. The significance of this fact is far greater during emergency situations.

The following processing is crucial in blood bank information systems [5,10]:

- Calculation of the cost of products consumed for the patient
- Calculation of the number of blood transfusions on a daily, monthly, and annual basis
- Calculation of the number of canceled blood transfusions
- Calculation of the blood bank inventory based on the type of blood products
- Calculation of the number of consumed blood units
- Calculation of the number of expired blood units
- Calculation of the number of infected blood units returned to the hospital's blood bank

In order to provide accessibility to various blood products and groups at any time, knowing the blood bank inventory and estimating the number of consumed units and products is impossible without performing statistical calculation. On the other hand, statistical calculations are the first step in collecting and recording the information accurately and properly. This is essential for decision-making, planning, and measurement of performances across various managerial areas. Considering these points, statistical calculations were performed in the blood bank of all the studied hospitals. Among various processing operations of blood banks is the administration of tests on the samples and blood units before blood transfusion, including compatibility tests and cross match [11].

According to the findings of this study, these tests were carried out in the blood banks of all the studied hospitals. The administration of these tests can prevent the incidence of any errors in identifying patients and blood samples that cause transfusion of incompatible blood into a patient. This depends upon ensuring the correspondence of the prepared blood units with the results of the processing during the implementation of the results of this processing with related technologies, especially regarding patients who require surgery. Across all the studied blood bank information systems, only "monthly reports related to the consumed blood products" were prepared and presented. Other types of reports were not prepared and presented in any of the studied systems. By preparing "the reports related to the status of blood products" one can gain access to information including product type, expiration date, product reception date, blood group and its Rh which can help prevent the product from decay and loss. By preparing "the report related to the patients" through entering the patient's record number, it is possible to gain access to information regarding the code and type of products consumed for the patient, the blood group, the time, and the date of product use. Through "the match and mismatch of the request with the blood bank inventory" report, one can be aware of the blood bank inventory at any time. The findings of this research indicated that 72.7% and 36.4% of centers send their reports "manually in the form of reporting forms" and "orally" (by phone and in person) respectively; none of these centers used the electronic method. However, it should be stated that sending the reports electronically within the blood bank section itself is not even possible. Nevertheless, blood bank sections should be in contact with institutes such as the deputy of treatment affairs, Health ministry, and blood transfusion organization to enable sending reports electronically and within the shortest possible time. Therefore, improvement of the communication of the blood bank information system leads to improved electronic transmission of reports to the centers. The incompatibility of blood groups of blood products and patients caused by human error is one of the most important problems related to blood transfusion. Its major cause is the occurrence of errors in the identification of patients and blood products at the patient's bedside [12]. One of the best strategies to prevent the incidence of errors during identification is the application of technologies of patient identification. Among these technologies are barcode, RFID, and electronic wristbands which make the collection of accurate data in the shortest time and with the fastest speed possible [13].

Barcode and RFID store data such as the number of blood bags, the blood group and Rh of products, the blood product type, and expiration date [14].

On the electronic wristbands, demographic information related to patients, their blood group, and Rh is registered [15]. By applying these technologies in blood banks, detection of information mismatch is performed conveniently, resulting in increased security and quality of care offered to patients [12]. This research indicated that barcode, RFID, and electronic wristband were not used in the studied hospitals. Statistical software were not used due to insufficient knowledge about their significance and application for utilization in blood bank information systems. These software programs have a high capability in calculating and displaying statistical indices. Furthermore, manual systems (blood bank registries, reporting forms, request on blood and its products…) are used to register and store data in all the research units. This is due to lack of trust to the computer systems by the staff and failure to estimate the statistical needs of the blood bank section through these systems. Therefore, by dispelling computer system problems and considering the advantages of electronic commerce that brings about increased speed and accuracy in performing activities and provides rapid and timely access to the data, the decisions to use proper hardware and software equipment should be made to estimate the needs of the blood bank sections. Additionally, it is implied from the findings of this study that barcode equipment is used in none of the studied hospitals. However, this technology can

contribute to keeping the security of information by decreasing human error and provide valid information without human involvement. The barcode label contains readable information that is capable of storing information related to blood and blood products in a large volume. This can assist the management of blood and its products. Regarding the users of the blood bank information system, divided the beneficiaries of blood bank information systems into three groups: donors, patients, and the blood bank personnel (employees in the blood bank such as staff, operators, the blood bank official, and the laboratory official) [11]. In this research, the donors were not included in the users of the blood bank information system of the hospital. The justification was that donation of blood was performed in blood donation centers outside the hospital. According to the statements of the personnel in the blood bank of the studied hospitals, no information related to blood transfusion was requested from the patients. It was also found that the physicians, nurses, financial and accounting sections, the medical record section, and the hospital's management are also among the users of this system. For instance, if any side reaction or complication occurs, the medical and nursing care team can get informed of the details and specifications related to the products and compatibility tests through access to the information available in the system in order to choose the best option in therapeutic decisions. Access to the computerized blood bank information system through HIS, made it easy for the financial and accounting sections to prepare bill for patients. The hospital manager and the medical record section are also members of the hospital blood bank committee and are considered as indirect users of this system. Regarding the standards used in collection, processing, and distribution of information, it should be stated that there was no written standard and instruction on collection, processing, and distribution of information in the blood bank systems of the studied hospitals. However, the existence of standards for documentation, accurate, concise, and timely reporting and the data quality control system result in reports with standard structure containing quality and timely data to be presented. Nevertheless, due to the absence of these standards, the blood bank reports were presented randomly (from time to time and sometimes inaccurate and incomplete) and with delay. Therefore, the existence of such standards seems vital.

CONCLUSION

According to the results obtained from this study, it is concluded that the blood bank information systems of all the studied hospitals were semi-mechanized. Accordingly, it was not possible to send the complete reports electronically in these blood bank units. The blood bank information systems failed to interact with the majority of systems inside and outside the hospital, especially with the Blood Transfusion Organization. Moreover, these systems were not able to present dynamic reports and had not used any specific software related to blood bank. Therefore, this study can facilitate needs assessment in order to implement mechanized blood bank information systems and recognize the strong and weak points of these systems for the design of systems matched with the needs of users.

"The authors declare no conflict of interest"

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