Analysis of Management Information System in Blood Transfusion Services, Pakistan

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Abstract

Background: Systems reforms are being implemented in the blood transfusion system in Pakistan through the Safe Blood Transfusion Programme. One of the key elements of these reforms is the installation of a synchronized computer based management information system. Currently the blood transfusion sector lack efficient tools for information and knowledge management, and process automation. The exchange of information is not possible among blood centres as they are not consistently regulated under the existing legislation, as the weak operational structure of Blood Transfusion Authorities (BTA) limited their outreach into the system. The present study was conducted to prepare a comparative analysis of the existing information systems in the Pakistani blood banks with the international systems and to explore the possibility whether integration of individual systems is possible.

Methods: Both quantitative and qualitative tools were applied to achieve the study objective, i.e. comparison of functional capabilities of existing MIS for BT with minimum required standards necessary for supporting safe blood transfusion process.

An analysis of six healthcare organizations providing blood transfusion services was done in Islamabad (federal capital) and Lahore (capital of Punjab Province).

Results: The study showed that only few blood transfusion establishments use some basic electronic information system, but these electronic information systems do not fully comply with the standards for safe blood transfusion and good automated manufacturing practice (GAMP). None of the establishments have a look back system implemented or any systematic approach of reporting critical aspects of their daily operations. Information reporting is irregular, incomplete and results are not reliable. The study visualized the data sets generated through a mapping exercise, proposed the horizontal and vertical boundaries of the system and possible links with other actors and their data bases.

Conclusion: Need for better information support was identified and two major information components were proposed which are Blood Transfusion Information System (to support routine processes of the Blood Transfusion Establishments), and Management Information System (to support management and decision making processes). There is also a need to support the establishment of surveillance and vigilance system and strengthen the "routine" data and information management systems.

Introduction

Health Management Information System (HMIS) is an integrated Management Information System (MIS) that collects management information about part, or whole health sector. MIS in blood transfusion (BT) is similar to HMIS but restricted to the assembly of BT-relevant information and serving BT-relevant management and statistics purposes. On many instances, MIS in BT functions within the broader HMIS. Efficient data and information management in blood banks contribute to the safety in each step of blood provision and transfusion and are essential in ensuring appropriate donor management, traceability and process control.

In Pakistan, a national HMIS was developed by the Ministry of Health in collaboration with the provincial Departments of Health and international donor agencies during 1990-93 [1,2]. However, in Pakistan's healthcare system, the application of MIS is not yet integrated due to the management approach and the arrangement of public sector systems [3]. One of key constraints faced by the health sector of Pakistan is the lack of access to reliable planning and performance data, which renders evidence-based decision making an elusive goal. This general situation is mirrored in the blood transfusion sector, with the result that policy-level decisions are at best based on anecdotal evidence, good guesses and biased understanding. It is obvious that such decisions do not always lead to the intended results. The prevailing circumstances lead to a situation where even basic data related to blood banks in Pakistan, like the total number of blood

establishments, their geographical distribution, their production capacities and other essential data, such as the number of TTIs detected and the quality of services provided by these facilities, are mostly missing. A centralized MIS is not present and the human and technical resources required for Blood Transfusion System (BTS) data analysis at the national and provincial levels do not exist.

In the National Blood Policy & Strategic Framework (2014-20), data management has been declared as one of the strategic zones [4]. This reform process of blood transfusion sector [5] includes the installation of a synchronized computer based management information system in all Regional Blood Centers (near completion) and linked Hospital Blood Banks (HBBs). This MIS will become a key tool for monitoring and decision making at system level, allowing for a national monitoring of blood safety indicators. In the planning document (PC-1) of the SBT Project, there is an allocation for the 'Development and Implementation of a Management Information System', which would be linked to the provincial blood programs and collect data on blood donors, blood collections, blood components, adverse transfusion reactions, Transfusion Transmitted Infections (TTIs), provide information for look back cases, etc.

The present study was conducted to prepare a comparative analysis of the existing information systems in the Pakistani blood banks with the international systems and to explore the possibility whether integration of individual systems is possible. The study also proposed the horizontal and vertical boundaries of the system and possible links with other actors and their data bases.

Material and Methods

Both quantitative and qualitative tools were applied to achieve the study objective, i.e. comparison of functional capabilities of existing MIS for BT with minimum required standards necessary for supporting safe blood transfusion process. A narrow approach was chosen to study only a limited number of blood transfusion establishments identified as prototypes. Collection of reliable information about nationwide availability has indicated that use of any type of electronic information system in blood transfusion has not been achieved due to many factors including loosening of centralized governance control over the healthcare sector due to recent constitutional amendments, time constraints of SBT project, limited understanding of information management terms and concepts in the blood sector and security situation in some provinces.

An analysis of six healthcare organizations providing blood transfusion services was done in Islamabad (federal capital) and Lahore (capital of Punjab Province). Organizations were designated a unique ID from BTE-1 to BTE-6. Two of them were in the public sector and the others were in the private sector. Three of the six facilities had an electronic information system (BTE-1 to BTE-3).Their information systems represented typical example of information environment that can be found in most of the BTE's equipped with MIS in Pakistan. Each of the information system was analyzed from basic functional and technical point of view.

Results

Out of six organizations, three were equipped with an information system to support processes in its blood transfusion establishment. Comparison of basic features and functions of these systems can be seen in Table 1. There is a clear co-relation between the available financial resources (initial budget and budget for annual running costs) and completeness, quality and safety of the information system. The major problem in the public sector, represented by BTE-1, seems to be a lack of financial resources for sustaining information management costs. Funding for the system is irregular and through either the international donors or the government which is not conducive to consolidating the achievements and gains. The private for-profit organizations also face funding issues but have better policy for long-term resource utilization and sustainability of the results. It is interesting that all of the IT systems in the centers studied use commercial, mostly licensed and rather expensive technology (Oracle and Microsoft database and application environment) and none of the three systems is based on any open source platform.

General		BTE-1	BTE-2	BTE-3
	Name of the software	HMIS (CRM)	HMIS	HOPe
	Software development company	CRM	In-house	In-house
	Budget (HMIS)	40 mio PKR	?	~ 40-80 mio PKR
	Annual running costs	?	?	> 15 mio PKR
SW modules	Module name	Availability	Availability	Availability
	Registration of donors	*	Y	Y
	Donation management	*	Y	Y
	Product management	Y	Y	Y
	Product screening results	Y	Y	Y
	LIMS interface	Y	Y	Y
	Product qualification	Y	-	Y
	Stock/distribution	*	*	Y

	Reporting and management support	*	*	*
	Other	Y	Y	Y
Critical system functions	Function	Availability	Availability	Availability
	Unique identification of donor	*	*	*
	User roles and access rights	*	*	Y
	Auditing	*	*	Y
	Unique identification of donation	Y	Y	Y
	Unique identification of product	Y	Y	Y
	Barcode automation	-	-	-
	Automated product labeling	-	-	-
	Traceability	-	-	-
	Security	*	*	*
Rem: Y (function available in the MIS), *(function partly available), -(function not available)				

Table 1: Comparison of studied BTE Information Systems.

In addition to funding, the other handicaps of the existing information systems include poor awareness of the significance of the information management, minimal awareness of data quality and low perception of the importance of general BT quality and safety guidelines. Organization of blood transfusion services is decentralized. Practically, every division organizes collection of BTS relevant management information individually. Regular reporting has been established only in Lahore in the Punjab province, but even this reporting does not cover activities of all BTEs. Present information sources are not only heterogeneous in content and format but in many cases, random, incomplete or missing at all. Information seekers have to search for information in many sources, standard information management processes do not exist, data quality is very poor due to lack of any data quality assurance and thus BTS relevant information (if exist) is not reliable. Situation of information seekers– federal, provincial and BT Authorities, as well as managers at district, hospital and BTE level - is illustrated in Figure 1.

Blood bank information systems used by some of the BTEs include modules covering core BT processes but its use is limited to the necessary minimum. Unfortunately many data entries were left non-mandatory and are not entered by the system users. This includes unique identification of donors, results of pre-donation questionnaire and medical investigation of donors (donors are not systematically screened at all). The confidentiality of donor information and compliance with blood regulatory authority requirements (under the blood safety acts) was missing in all centres. The donor information is recorded and made available through the patient identification number. This is attributed to the high percentage of replacement donations in the country. Donation results are recorded but bleeding time as well as any donation events that might endanger quality and safety of the product is not recorded in information systems. The systems are able to provide various reports but most of them are not or cannot be used due to the poor use of the system functions (insufficient data recording by the BTEs' staff) and lack of experience with modern information-based decision making at managerial level.

Backup devices are installed and operational but no formal description of the backup and restore procedures exist in most cases and backup media are usually stored in the same room as the servers.
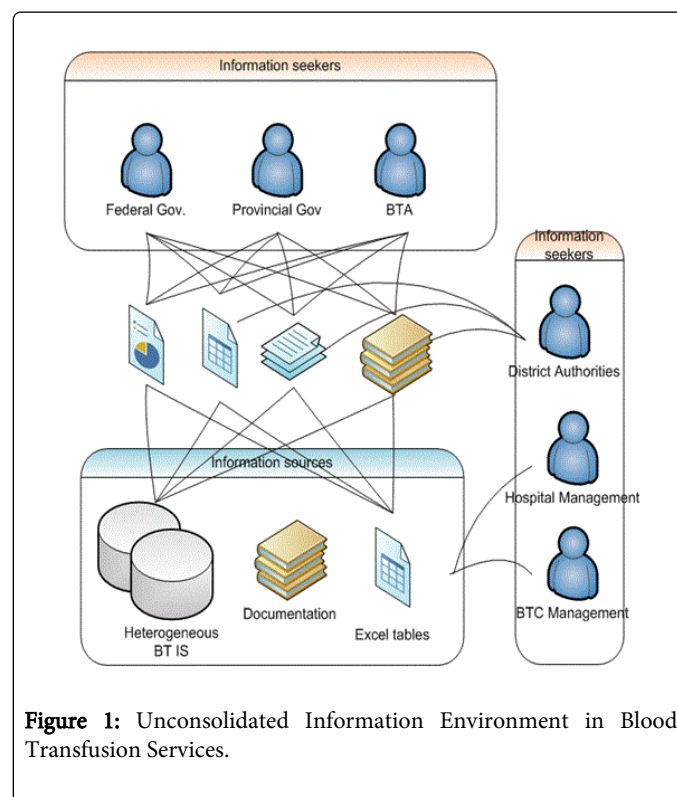

Figure 1: Unconsolidated Information Environment in Blood Transfusion Services.

Discussion

In general, it can be stated that BT system in Pakistan lacks mechanisms at the national or provincial level to enable the exchange

of information among blood centres on all aspects of vein to vein transfusion chain, i.e. processing, screening, storage, transportation, cold chain and inventory management. Systematic approach of data reporting about BTE activities does not exist in most of the provinces. Current information solutions do not fully comply with the necessary standards for safe blood transfusion. Therefore, solutions need to be improved to better support the future processes in the Regional Blood Centers being developed through full utilization and support of bar code automation, enabling full traceability of blood, provision of data quality and information safety supporting unified interfaces with MIS, etc.

A national Management Information System needs to be established to support statistical reporting, planning and management (including management of quality and safety). The option to adopt an existing information system currently used in BTEs, has one major drawback: these information systems support processes based on replacement and paid blood donation scheme and do not fully comply with the necessary standards for safe blood transfusion, which in contrary is based on voluntary non-remunerated blood donations. Moreover, none of the system was built to be used by a chain of collaborating BTEs and the change of its concepts would be similar in scope to a completely new development.

The MIS system should be suitable for local requirements, however, novel functionality and flexibility comes at a higher price [6]. Many of the management information systems offered in the local market commercial or developed internally have rigid design and lack development support, so changes are not straightforward and it is not easy to identify adequate prospective local blood bank management information systems. Prominent international providers of the BT MIS can provide sophisticated information systems but their price currently exceeds funding options.

From technical point of view four basic alternative solutions are feasible for the implementation. Each solution has its specific advantages and drawbacks and may not be suitable for the general project context:

Stand-alone IT implementation in each Regional Blood Centre

Peer-to-peer Network between Regional Blood Centers (de-centralized MIS)

Central Datacenter, connected to all Regional Blood Centers

Cloud-based data management with access for all Regional Blood Centers

Stand-alone IT systems represent current status in some of the BTE's. Even modernization of the existing systems to comply with latest donor safety and process quality requirements lacks one of the necessary requirements, i.e. ability to share information about donors as well as ability to enforce and monitor unified process standards and provide reliable and uniform managerial information.

Peer-to-peer system has the potential to overcome basic disadvantages of the stand-alone variant. Each BTE will be equipped with local servers and will use its own information system like in stand-alone variant. If equipped with appropriate interfaces and services as well as centralized quality rule-base maintenance system, the information can be exchanged between RBC's and common policies/set of rules could be reinforced. All RBC's may use either the same or different but compatible information systems. De-centralized system architecture is quite common in many European countries and

represents one of the evolution steps towards centralized system architecture. It is less dependent on internet and does not require broader collaboration between BTEs. Each BTE is funding its own information system and only part of the system (central MIS, central registry of donors, etc.) needs to be co-funded by participants or from central budget. This might be important advantage in the Pakistan context. However, overall costs and long-term homogeneity and efficiency as well as ability to enforce common safety and quality standards are in question in Pakistan, as well as ability to find enough local technical resources necessary for maintenance and safe operation of the system.

Centralized system and cloud based system are only two alternatives of the same system architecture. Cloud solutions use cloud services (e.g. servers, backup systems, security systems, virtualization services) as third party services to run centralized, generally web based (not necessarily) information systems. Important precondition for centralized system operation is of course availability of fast, reliable, non-interrupted internet service at all connected BTE's, building of at least two independent data centers with data replication, use of certified security elements (switches, firewalls) and backup devices. All of these components are available in Pakistan and a possible central system architecture can be seen in figure 2.
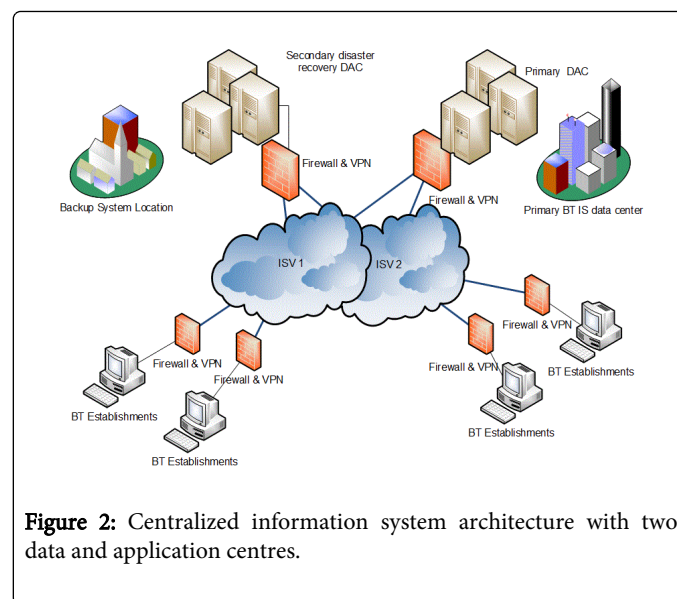

Figure 2: Centralized information system architecture with two data and application centres.

The estimated overall costs under the SBT project (installation, development, maintenance and training) are also substantially lower for the centralized solution because centralized server capacities allow better utilization and load balancing, easy maintenance and control, safer operations and less demand on highly trained technical staff and administrators in comparison to the de-centralized system. System security could be better established and safeguarded and system security policies could be easier enforced over the whole BT system then in case of de-centralized system architecture with many local servers and backup devices. Centralized MIS, especially BT IS, naturally support information sharing in BT. Centralized database of donors will allow donors mobility and radically improves donors' and patients' safety and BT quality. Centralized architecture of MIS does not automatically refer to centralized data possession. Ownership of the information should be within the domain of respective parties (regional blood centres, hospital blood banks and regulatory authorities) and their ownership should be in line with relevant

policies, legislation and regulations. Data access rights must be applied in the information system as fragment of its elementary security policies. Type and level of information shared among different users have to be based on consensus as data sharing is more a regulatory issue rather than technical. Therefore, 'Good Governance' of information could rely on a 'code of practice' to be developed and considered in staff contracts.

Conclusion

A new blood transfusion system will need two different but interlocking types of information solutions [7]; (1) BT Information System (support of routine processes of the BTEs); and (2) management information system (MIS) for BT (support for management and decision making processes). It is noticeable that there are adequate professional capabilities within Pakistan that are able to shape professional IT solutions. However, it is also essential to create national healthcare IT standards which are aligned with international standards and also custom-made to fulfil current and future needs of the information systems in BTS. For these reasons we recommend to use present information solutions as basis of knowledge and experience and to develop new information systems grounded on the finest international examples and standards by open source and free technologies. The MIS needs to be designed to be both user friendly, practical, serve essential objectives and remain open to further development, should technical, legislative and budgetary conditions allow so and user demand require this. A newly introduced MIS should not overwhelm users and should have enough flexibility to be used in facilities of different levels of technical and budget resources.

Future information solutions for safe blood transfusion in Pakistan should support better sharing of critical information about all aspects of blood transfusion process as well as managerial and statistical information for efficient management and decision making. Centralized and cloud based architecture should be used wherever information infrastructure (first of all reliable internet connectivity) allows, as the most cost efficient and modern prospective solution [7]. Pakistan should focus on implementation of necessary standards and regulations to allow broad information exchange and sharing in healthcare and in BT.

Author Contribution

The study was conceptualized by HK and UW. Data collection was done by HK and UW. Literature search was done by HK and RK. HK, UW and RK drafted the manuscript. HAZ supervised the project and revised the manuscript.

Conflict of Interest

HK and RK visited Pakistan in 2011 and 2012 as GIZ consultants for the Safe Blood Transfusion Programme.

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