

Understanding the Implementation of an Electronic Hospital Information System in a Developing Country: A Case Study from Pakistan

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Abstract

Literature on implementation of hospital information systems is scarce, especially with regard to developing countries. Pakistan Institute of Medical Sciences (PIMS) is a large public sector hospital in Pakistan that successfully implemented a hospital information system (HIS). This article studies how this success was achieved and examines the hurdles faced in the implementation of the HIS and how they were overcome. The article aims to provide a better understanding of implementing HIS in a developing country setting, to add to academic knowledge in the area as well as to serve as a guide to anyone wishing to implement an HIS in such a setting.

Keywords: health informatics, hospital information systems, system implementation, developing countries, Pakistan.

1. Introduction

Hospitals are the main healthcare providers in developing countries (Clifford, Blaya et al. 2008). For this reason hospitals ought to be the primary target institutions when aiming to improve health information systems in developing countries. However electronic information systems in hospitals in developing countries are “rare to nonexistent” (Rotich, Hannan et al. 2003). In an environment where the awareness and appreciation of electronic hospital information systems (HIS) does not exist, implementing^a an HIS would be a

serious challenge (Idowu, Cornford et al. 2008). Against all odds, if a hospital in a developing country did decide to transform its information system and implement an HIS, there would be surprisingly sparse literature on useful experiences to guide that hospital through the transformation. This is because literature on “implementation”^a of hospital information systems is extremely limited (Ovretveit, Scott et al. 2007), and whatever literature is available is predominantly from developed countries where the circumstances, systems, processes, and cultures are different from that of developing countries.

This paper attempts to improve the understanding of HIS implementation in a developing country setting firstly by reviewing the literature on HIS implementation, and then by presenting a case study of HIS implementation in a large tertiary public-sector teaching hospital at the Pakistan Institute of Medical Sciences (PIMS) in Islamabad, Pakistan.

2. Methodology

The literature reviewed included papers that directly or indirectly presented information on HIS implementation with a special but not exclusive focus on developing countries. The case study was a qualitative study carried out in PIMS from August to September 2007. PIMS was selected for the study because it is the only public sector hospital in Pakistan that has successfully implemented a fully functional HIS. “Successful”

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^a Implementation here is taken in the broad sense that includes development and deployment of the electronic information system

implementation was defined as the system installed institution-wide, with users routinely using and being satisfied with the system. PIMS was also selected because it's HIS was developed wholly within and for that particular institute, making it a very developing-country-oriented system. Otherwise the general trend in developing countries is for HIS projects to be "funded through various sources from international donor and aid agencies to local non-governmental organizations"(ITG 2001). Finally, PIMS was chosen because it presented a success case, as opposed to a failure case, which is thought to be more informative for an implementer rather than a failure case. Success cases also highlight challenges and barriers and learning how these are overcome increases the understanding about the challenges and barriers. Failures are however more commonly seen in the domain of health informatics (Berg, Aarts et al. 2003; Heeks 2006).

The methods of the case study included in-depth interviews of five key informants and twenty users, informal conversations, study of documentation and observations carried out over the study period. The selection criterion for the key informants was that they have been involved with the project from its initiation to the present. Notes were taken during interviews and reviewed on a daily basis. Contradictions were clarified with the informants the following day. Validity of information was determined through comparative analysis of data from the different sources. Data analysis was carried out by studying and mapping emerging themes.

3. Literature review: experiences of implementing HIS

The classic works documenting experiences of implementing ICT projects are "Leading Change" (Kotter 1996) and "Crash" (Collins and Bicknell 1998). Kotter lists the sense of urgency, powerful coalition, creating a vision, communicating the vision, empowering others, planning for short-term wins, consolidating improvements and institutionalizing new approaches as key factors leading to successful implementation. Kochers on the other hand focuses on failure factors and identifies over ambition, complacency, over-rating computer technology, over reliance on ICT professionals and ICT consultants, undue confidence in the power of the contract to penalize an underperforming ICT company, and trust in costly custom built software as key factors.

From the literature accessed for this study, social factors were identified to be more critical than the technical factors when determining the success of implementation. The most common factor observed in the literature that influenced the

success of HIS implementation related directly or indirectly to change management, pointing out the necessity of formal managerial skills to manage the transformation, the need for effective communication channels, and the importance of a vision for change (Berg, Aarts et al. 2003; Lorenzi and Riley 2003; Alvarez 2004; Kensing, Sigurdardottir et al. 2007; Ovretveit, Scott et al. 2007). Extensive upfront planning (IT 2007; Frame, Watson et al. 2008), securing political support (Cassels 1995; Alvarez 2004), and implementation from the top (Ovretveit, Scott et al. 2007b) were also identified as important success factors. Associated with these factors was mention of the characteristics of leaders (Berg, Aarts et al. 2003; Lorenzi and Riley 2003; McGrath 2006; Frame, Watson et al. 2008). These included beneficial characteristics that led to success (e.g. transformational type, physician-champion, senior), and detrimental characteristics that predisposed an implementation to failure (e.g. over committed and emotionally involved leader).

Consideration of the end user was the next most commonly identified factor. Raising users' understanding of the requirements and benefits of change, as well as ensuring user participation in the design and development of the system were identified (Kuhn and Giuse 2001; Meijden, Tange et al. 2001; Ball 2003; Alvarez 2004; Igira, Titlestad et al. 2007; Kensing, Sigurdardottir et al. 2007; Kyhlback and Sutter 2007; Ovretveit, Scott et al. 2007; Soriyan, Ajayi et al. 2007; Frame, Watson et al. 2008). Regarding user involvement it was pointed out that the difference between genuine user involvement and users being mere informants should be borne in mind.

In failures, as opposed to successes, software emerged as a ubiquitous factor. Over ambitious projects, complexity of the project, scope creep, poor user-interface design, lack of clarity on the functionality required, and lack of sensitivity to the local systems were identified as important failure factors (Cassels 1995; Collins and Bicknell 1998; Lorenzi and Riley 2003; Heeks 2006; Kyhlback and Sutter 2007; Lucas 2008). One paper (Sicotte, Denis et al. 1998) described the inappropriateness of a normative approach adopted in the project whereby new realities were imposed through the HIS. This forced uniformity and predictability in care delivery and consequently the system did not get accepted by the physicians because that was not how physicians thought or worked. Furthermore, tried and tested systems that were intuitive and required little or no training were said to reduce failure rates (Ovretveit, Scott et al. 2007a).

The articles from developing countries, in addition to touching on some of the factors listed above, identified other issues more fundamental in nature. These included the lack of adequate electricity supply, lack of computer infrastructure,

lack of funding, unsustainable funding, and the low level of educational of the technical staff who, rather than the clinicians, tend to be the primary users of the system in developing countries (Chandrasekhar and Ghosh 2001; Rotich, Hannan et al. 2003; Gordon and Hinson 2007). Idowu, Cornford and colleagues (2008) identified the government's lack of appreciation of the value of IT in healthcare, cost, Internet connectivity, and lack of maintenance culture as further obstacles.

4. Study results: experience of implementing the HIS at PIMS

When the idea of an electronic hospital information system was first conceived in PIMS in 1996, the foremost implementation barrier was the lack of interest in such an initiative. There was no mechanism at the hospital by which to formally seek internal or external advice on this issue. This initiative therefore had to become the personal effort of an enthusiastic physician, who championed its initiation, development and deployment.

In terms of infrastructure, there was a complete lack of information technology (IT) hardware in the hospital. The pathology department was the only department that had one old computer. The initiation of the HIS at PIMS was based on small donations. One old Pentium II computer was purchased which was setup as a makeshift server while the older existing computer was placed as a terminal at the registration counter of the pathology department.

When it came to identifying software, there was no off-the-shelf software available in the local market. At that time open source software was not much developed and PIMS could not afford the commercially available software that would have required significant customization. Furthermore, these were untested for local conditions, and too sophisticated and complex for the level of IT expertise available at PIMS. Through personal networks of the physician champion however, a software vendor was identified who agreed to deploy eight programmers in the hospital who would develop the HIS software application in house free of cost. Being an IT company, the vendor had expert knowledge and skills in application development. Basic HIS knowledge was gained from the Internet. Initial development focused only on the registration function of the pathology department that was installed on two nodes, one of which was placed in the office of the head of department (HOD) of pathology. After the HIS was developed and deployed successfully, it demonstrated its value as well as the potential for expansion to other functions of the department. With this expansion there was need for more

hardware, so more hardware donations were sought from companies, particularly those that regularly upgraded their systems. This led to the acquisition of additional second hand computers and one old server.

The expansion of the system in the pathology department however meant that it would require other staff and not just the already enthusiastic HOD of pathology to use the system. This was the greatest challenge as it meant changing the perceptions (and in many cases misperceptions) and attitudes of the staff to this "alien" technology. It also meant changing work routines and work practices, which the technical staff was so used to and comfortable with. The technical staff (who typically run departments in developing country settings) of the pathology department were to be the main users of this system. These technicians however, typically coming from the lesser educated background had either never or very rarely come across a computer. Many were intimidated by the thought of having to work with a computer because it was either perceived as a threat to monitor and penalize them, or because they thought that exposing their lack of computer abilities might mean they would lose their jobs. How this change was led merits an independent paper in itself, but very briefly the main strategy for this was holding countless formal and informal discussions. Many assurances and much support had to be given so much so that the IT people developing the software had to at times sit as computer operators entering the data.

Round the clock support was offered with the HOD himself always on-call to attend any failing of the system, ranging from the simplest problems like changing paper rolls in the dot matrix printer to more serious issues like the database crashing or the physical breakdown of the exposed network of Ethernet cable. The physical breakdown of the network sometimes happened as a result of deliberate action to sabotage the progress of the system development. It is important to note that pursuit of the offender was considered counterproductive so was never undertaken. Instead, based on the experience of each incident, the system was made more secure.

For a long time both the computer and paper based systems ran in parallel. Staff started inputting data into the electronic system during off-peak times, initially with the IT "staff" sitting next to them or even doing it for them. This was seen to significantly encourage the technical staff to use the system. Later IT "staff" only helped during peak-times. Only when the staff started using the system were they able to appreciate its benefits. They began to feel ownership of the system, the proof of which was that they themselves ensured that whenever there was a failing, it was promptly reported and restored. Using the system also

resulted in many suggestions of improvements coming from the technical staff, which led to its refinement and improvement. Only after the staff became fully confident at inputting data electronically was the paper-based system discontinued. Training of new staff, ongoing staff training and refresher courses became an important ongoing part of the system.

While developments were happening in the pathology department, the championing physician also started having discussions with other departments. Radiology was the next most willing department that showed an interest in implementing the HIS. So development of software for the radiology department commenced. At this time it was realized that the main registration counter of the hospital was collecting the same information that the pathology and radiology registration desks were collecting. To avoid this redundancy, registration was unified and centralized between the main registration counter, pathology and radiology departments by connecting a couple of computers of these departments.

In the expansion of HIS to other departments and wards, disinterested and skeptical medical doctors, nurses and technical staff were constant barriers. Doctors and nurses had not been exposed to any electronic health system through past training or working environments, and because of their lack of awareness they became indifferent to the implementation of this system and showed no encouragement, support, or commitment. However, when the pathology and radiology information systems were up and running, the other departments of the hospital started to receive pathology and radiology reports in electronic format. These outputs led to a decrease in the skepticism of HIS by the clinicians and an increased interest in the electronic system as they could visibly see outputs and realize the benefits. This paved the way for discussion to further expand the information system by developing software modules for other departments.

Gaining political support at the senior management level was an insurmountable challenge, at least at the outset. As the department of pathology initiated the project, there was no institutional ownership and interest in the system. Constant dialogue and demonstration of the value of the system to the stakeholders through seminars and meetings was undertaken to resolve this problem. Changing management which, like other developing countries, is not infrequent in Pakistan, brought in different personalities with different ideas, some of them reluctant on HIS and others keen (or at least not reluctant). However the championing physician was very committed which helped in tackling the lack of political support in the early stages. Once the implementation process

had reached a stage where stopping the systems running in pathology and radiology would have led to chaos, the system became viable against political barriers. Further development and expansion of the system however had to be undertaken in a stealth and low-key manner.

5. Discussion and conclusions

There are many similarities between the PIMS experience and what is seen in the literature. However there are key differences as well which need to be highlighted.

From the literature, formal upfront detailed planning and management that includes forming strong coalitions emerge as key factors to drive the implementation, institutionalization and acceptance of a system. In the case of PIMS no detailed planning was carried out beforehand and there was no formal management of the project. Detailed planning would have necessitated thinking at an institutional level. However, the departmental-level small-gains focus adopted in PIMS is thought to have been a key factor in the successful implementation of the system through a step-wise approach to meet every emerging need. Each step was taken to successful completion before proceeding to the next step. This did not indicate a lack of institutional vision; it was important for the champion to have the greater vision in order not to miss valuable opportunities of development and expansion when they arose. The departmental-level small-gains approach meant that emerging needs shaped the institutional vision rather than some preconceived inflexible grand institutional vision driving the change.

Also relevant to this point is the lesson learnt from the study that a strong and visible coalition at senior management level is not mandatory for the success of HIS implementation. Because there was no buy-in from the senior management or other departments initially, institutional recognition and acceptance did not exist and a single-person driven, stealth and low key approach had to be adopted. This strategy worked successfully in PIMS. The fact that the champion was a senior, well-connected and well-respected clinician, who was passionately dedicated to establishing the system, was also a key factor in its success. However, it is also important to note that the champion (and his "team") worked very closely, at a personal level, with the primary users to "convert", train, and support them. So while coalitions to drive the system implementation from the top were not formed, strong networks of users were formed at the grass-root level that progressively expanded. Training of the users was carried out on a one-to-one, on-site and hands-on basis rather than in the more theory-based

traditional “class-room” style. This seemed to have been better accepted by the users.

The key factor that led to user acceptance was the practical usage of the system. It seems to have worked well to “release” the system in its infantile stage of development thereby engaging the users early in the development process leading to their “real” involvement. Only when the technical staff experienced using the system did they realise its value. They were then able to identify how it could be improved, which was critical in the development of a system that was suited to the local requirements. Early involvement also put the users at the leading end, enabling them to help develop the system, rather than being at the receiving end where the end users are imposed an “externally” developed system. All this worked in favour of user acceptance.

The factors leading to institutional acceptance were similar to those of user acceptance. When the stakeholders saw the outputs of the PIMS system, e.g. pathology and radiology reports, they were able to realize its benefits. This eventually led to the institutionalization of the system.

It is important to note that an “evolutionary” approach was taken throughout the implementation process where both staff and the system evolved and matured together. Software development and changing people’s attitudes were interrelated and required time but, contrary to evidence from the literature, no sense of urgency was introduced. Had it been introduced, it might have been detrimental; by not letting the change “sink in” slowly there would not have been enough time for the users to understand, appreciate, and accept the system. It is equally important to note that a “revolutionary” approach was avoided, particularly in software development. The initial design was kept as similar in layout as possible to the paper-based forms. This helped to initiate the implementation process without unnecessary conflicts.

Evidently, successful implementation of HIS in a developing country setting is very possible. The implementation of HIS in PIMS is an example of the successful implementation of an institution-wide information system against all odds, in a hospital in a developing country where no prior electronic information systems existed. It is however important to realize that the circumstances in developing countries are different from those in developed countries, which is where most of the experience of, and guidance for, implementing HIS comes from. When implementing HIS in developing countries, context-specific circumstances, barriers, and needs must be taken into account. System implementation should be seen in the wider context of organizational change, of which software development is but one part.

References

- Alvarez, A. J. S. (2004). "Challenges to information systems implementation and organisational change management: insights from the health sector in Ecuador." The Electronic Journal of Information Systems in Developing Countries **16**(6): 1-16.
- Ball, M. J. (2003). "Hospital information systems: perspectives on problems and prospects, 1979 and 2002." International Journal of Medical Informatics **69**: 83-89.
- Berg, M., J. Aarts, et al. (2003). "ICT in health care: sociotechnical approaches." Methods of Information in Medicine **42**: 297-301.
- Cassels, A. (1995). "Health sector reform: key issues in less developed countries." J Int Dev **7**(3): 329-347.
- Chandrasekhar, C. P. and J. Ghosh (2001). "Information and communication technologies and health in low income countries: the potential and the constraints." Bulletin of the World Health Organization **79**(9): 850-855.
- Clifford, G. D., J. A. Blaya, et al. (2008). "Medical information systems: a foundation for healthcare technologies in developing countries." BioMedical Engineering OnLine **7**(18): 1-8.
- Collins, T. and D. Bicknell (1998). Crash: learning from the world's worst computer disasters, Simon & Schuster Ltd.
- Frame, J., J. Watson, et al. (2008). "Deploying a Culture Change Programme management approach in support of information and communication technology developments in Greater Glasgow NHS Board." Health Informatics Journal **14**(2): 125-139.
- Gordon, A. N. and R. E. Hinson (2007). "Towards a sustainable framework for computer based health information systems (CHIS) for least developed countries (LDCs)." International Journal of Health Care Quality Assurance **20**(6): 532-544.
- Heeks, R. (2006). "Health information systems: failure, success and improvisation." International Journal of Medical Informatics **75**: 125-137.
- Idowu, P., D. Cornford, et al. (2008). "Health informatics deployment in Nigeria." Journal of Health Informatics in Developing Countries, 2, from <http://www.jhfdc.org/index.php/jhfdc/issue/view/4>.
- Igira, F. T., O. H. Titlestad, et al. (2007). Designing and implementing hospital management information systems in developing countries: case studies from Tanzania-Zanzibar. HELINA 2007/12th JFIM. Mali, Service d'informatique medicale.

- IT, A. (2007). "IT Executives Offer Advice for Adopting Electronic Records." iHealthBeat, from <http://www.ihealthbeat.org/Articles/2007/5/21/IT-Executives-Offer-Advice-for-Adopting-Electronic-Records.aspx>
- ITG (2001). eHealth in developing countries the future of health care? Information Technology for Health in Developing Countries, Harvard University, Centre for International Development at Harvard University.
- Kensing, F., H. Sigurdardottir, et al. (2007). "MUST - a participatory method for designing sustainable health IT." Studies in Health Technology & Informatics **129**(2): 1204-1208.
- Kotter, J. P. (1996). Leading change, Harvard Business School Press.
- Kuhn, K. A. and D. A. Giuse (2001). "From hospital information systems to health information systems." Methods of Information in Medicine **40**: 275-287.
- Kyhlback, H. and B. Sutter (2007). "What does it take to replace an old functioning information system with a new one? a case study." international Journal of Medical Informatics **76S**: S149-S158.
- Lorenzi, N. M. and R. T. Riley (2003). "Organizational issues = change." International Journal of Medical Informatics **69**: 197-203.
- Lucas, H. (2008). "Information and communications technology for future health systems in developing countries." Social Science & Medicine **66**: 2122-2132.
- McGrath, D. (2006). "How to motivate physicians and develop a physician champion." J Med Pract Manage **13**(6).
- Meijden, M. J. v. d., H. Tange, et al. (2001). "Development and implementation of an EPR: how to encourage the user." International Journal of Medical Informatics **64**: 173-185.
- Ovretveit, J., T. Scott, et al. (2007a). "Implementation of electronic medical records in hospitals: two case studies." Health Policy **84**: 181-190.
- Ovretveit, J., T. Scott, et al. (2007b). "Improving quality through effective implementation of information technology in healthcare." International Journal for Quality in Health Care **19**(5): 259-266.
- Rotich, J. K., T. J. Hannan, et al. (2003). "Installing and implementing a computer-based patient record system in sub-saharan Africa: the Mosoriot meical reocrd system." Journal of the American Medical Informatics Association **10**(4): 295.
- Sicotte, C., J. L. Denis, et al. (1998). "The computer-based patient record challenges towards timeless and spaceless medical practice." Journal of Medical Systems **22**(4): 237-256.
- Soriyan, H. A., A. Ajayi, et al. (2007). The context of MINPHIS development and deployment in Nigeria. HELINA 2007/12th JFIM. Mali, Service d'informatique medicale.