Literature Review:
Barriers to the Successful Implementation of Healthcare Information Systems

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FOREWARD

Before reading this review of the literature on barriers to the successful implementation of healthcare information systems, or HIS, the reader must know that there is little consensus or conformity in the terminology used to describe and examine the numerous forms of HIS within the United States (US) and abroad. Computer-based patient record, or CPR, is an umbrella term commonly used within the US to describe HIS. The term CPR gained acceptance from the Institute of Medicine in 1991, which led to its adoption in the US[1,2]. The term electronic medical record, or EMR, however, is most commonly used abroad. Generally, the terms CPR and EMR are synonymous, and the choice in use depends largely upon who is referring to them. References to HIS are so numerous that it contributes to the difficulty in defining HIS in concrete terms, and ultimately the difficulty in integrating them into the clinical setting[1].

For the purpose of this literature review, the term healthcare information system, or HIS, will be used. The choice in using HIS is an attempt at encompassing the CPR, EMR, and the various other systems used within the field of medical informatics. The following names are also used to describe HIS[3, 1]:

- Electronic patient record (EPR)
- Computerized patient record (also known as HIS)
- Computer-based patient record system (HIS)
- Computer-based patient record-type system (HIS-type system)
- Electronic patient record (EPR)
- Virtual patient record (VPR)
- Virtual health record (VHR)
- Electronic health record (EHR)
- Lifetime data repository (LDR)
- Electronic medical infrastructure (EMI)
- Automated medical record (AMR)
- Computerized medical record (CMR)
- Patient care information systems (PCIS)

While there is little consensus on a definition of HIS and a lack of standardization across systems in data collection components[1,4], the overall goal of these various systems is the same: improve the quality of patient care. As noted by Ball, Peterson and Douglas[5], the HIS should not be viewed as a product, but rather a process in healthcare

technology which has the goal of improved patient care. This view redirects attention to the focal issue of successful implementation, and away from arguments over semantics.

STATEMENT OF THE PROBLEM

Healthcare is, in large part, an information driven field. Clinical practices rely heavily on the collection and analysis of medical data for decision-making abilities when caring for patients[6]. The patient record is the compilation of medical data and information in its numerous forms[7], and is the cornerstone of healthcare information systems, or HIS, which are capable of having a significant, positive impact on patient care within healthcare settings[4,7,8,9,10,11,12,13,14,15]. HIS have been recommended for adoption by the Institute of Medicine as a strategy in improving the quality of patient records[5]. In fact, improvement in quality of care is a foremost concern and driving force in the use of HIS[14].

However, there is a long history of difficulty in successfully implementing HIS, beginning with their onset in the 1970s[8,9,16]. In many cases, attempts at HIS implementation have failed[3]. In other words, there is a gap between the quality of care improvements made possible by HIS and the ability or willingness among health care professionals to use these systems. The sources of this problem are diverse, and reflect the extent of the progress that must be made in order for the full public health potential of HIS to be realized: improved patient care through improved patient records[2].

This review of the literature will first offer background information on HIS, focus on the problems associated with their successful implementation into the clinical setting, and lastly offer guidance on how success may be achieved.

CHARACTERIZING HEALTHCARE INFORMATION SYSTEMS

Medical informatics

The development of health information systems, or HIS, takes place within the field of medical informatics[17]. Medical informatics is the study of the management and use of healthcare and biomedical information, and aims to assure that such information is used as effectively as possible for the greatest benefit to patients' health. Medical informatics encourages improved healthcare through improved quality of medical records[6,13]. Medical informatics also focuses on the development of HIS that may be more easily integrated into the clinical setting for use by healthcare professionals, with attention to assured patient privacy and confidentiality. This field is centered on the

development of standards in medical terminology and data collection, which are vital in any attempt to aggregate and share data from various locations or across different HIS[6].

The nature and potential of healthcare information systems

The various forms of HIS are best described as a continuum[1,12]. This continuum has five stages, ranging in increasing complexity and difficulty in successful implementation. While stage one of the continuum uses the HIS in tandem with the traditional paper based system, stages two through five increasingly move away from paper based medical records to those that are completely electronic and capable of being linked with other clinics and hospitals[1]. Decision support systems, capable of notifying healthcare professionals of errors in patient care, are at this end of the continuum[6]. While all stages of the HIS have been difficult to implement into the clinical setting, this is especially true for decision support systems which have been viewed by providers as interfering with their judgment, not helpful, and too cumbersome and complicated to use[18]. Importantly, paperless medical records are not necessarily preferable but are only a matter of preference. In many cases, the paper record is a necessary complement to the organization of the clinic[19].

In general, the ideal HIS provides quick access to a patient's full medical history and health information, and accessibility to data that are not easily found within the patient chart[7,15]. This improves the quality of patient care through improved patient records[2]. HIS help ensure that patient data are accurate through quality assurance checks[4,11,12]. HIS also allow healthcare professionals to more easily and more quickly track the quality of patient care provided and measure changes in health status through the use of automated summary reports which examine patient data according to disease, procedure, provider, and quality assurance measures[1,3,4,11,12,13,15,20]. In this way, the HIS allows healthcare professionals to routinely monitor and ask questions about their patient populations that were previously very time consuming, if not impossible, to answer[8,11,12]. Some HIS allow users to quickly generate reminder letters to be mailed to patients to inform them of needed laboratory work, services, and preventative care measures. Reminder letters also help ensure that providers offer services in a timely manner[2,9,16,19,20] and help ensure that providers do not inadvertently overestimate the amount of services they provide. Additionally, HIS can encourage patients to become more actively

involved in their own care through self-monitoring of behavioral modifications such as beginning and maintaining exercise regimens[10,11,21].

In short, a successful HIS must enhance the quality of work within the clinical setting and promote improved patient care. The ideal HIS, however, does not yet exist[7,8,17]. Furthermore, what is ideal within one healthcare setting may not be deemed so in another, and what is considered to be ideal may change over time[3].

BARRIERS TO THE SUCCESSFUL IMPLEMENTATION OF HEALTHCARE INFORMATION SYSTEMS

There is generally no one reason for difficulties and failures in implementing HIS[12,17]. Furthermore, while certain factors appear to be major contributors to the failure of many HIS, there are no data to measure the relative importance of each potential cause of failure. In the literature however, there are two approaches taken to explore the barriers to successful HIS implementation. The first of these approaches, the most common in the literature, is the analysis of critical factors important to the successful HIS which offer specific guidelines or formulas for implementation. The second approach, the sociotechnical approach, is critical of offering specific formulas for success and treats such approaches as attempting to place healthcare systems within the standardized, predictable context of information technology systems[3]. The sociotechnical approach does not offer a formula for success[12], but instead strives to successfully implement HIS within what it deems a "politically textured process of organizational change"[3(p88)].

This literature review will deal with each of these approaches separately, beginning with the specific factors in successful implementation, and then continuing with the sociotechnical approach. Both approaches, when used in tandem, may result in the greatest degree of success among HIS. There is a certain domino effect that can take place during the HIS implementation process: One problem, when left unsolved, may lead to another problem, and in turn yet another and effectively halt the HIS[17].

Critical factors in successful implementation

Usability

Introducing HIS into a clinical setting involves a certain degree of redesigning the way the office works. Time, training, and/or monetary investments are also necessary for providers and staff to adequately learn how to use the new system[1]. Hersh[6] considers the

initial time necessary to proficiently learn and use a HIS is sometimes the main obstacle to their successful implementation; regardless of the savings in time, reduction in errors, and improved patient care that can result[6,15]. Provider belief that there is no need for improvement in quality of care offered can enhance resistance[15]. Overall, reasonable expectations for the benefits of HIS must be set and understood by all users[12].

Integration of HIS into an existing workflow, and the need for user acceptance, is made increasingly difficult due to the already demanding pace and responsibilities of the clinical setting. In effect, the benefits of a HIS, or its usability, must outweigh the costs associated with its implementation. As noted by Slack[14], providers will use computer applications and HIS if there is significant benefit to their practice in the sense of time savings, increased convenience in locating patient data, and quick analysis of specific patient data. While the initial investment in time and energy may seem substantial to healthcare professionals, the improved patient care resulting from HIS is primary among motivational factors[6,11,22].

Leadership

Strong leadership within the clinical setting in support of the HIS is crucial in successful implementation. These leaders, referred to as "local champions,"[17(p116)] or "system champions,"[12(p345)] are healthcare professionals, not necessarily providers, committed to using the HIS to improve quality of care. They understand the benefits of HIS and will work towards this goal. Generally, these leaders are already accepted and considered to be leaders within their practices, will work with providers and staff to gain their support, will learn the system him/herself, and will help explain the HIS to ease any apprehensions[11,15]. With this internal backing and commitment, other healthcare professionals are more likely support, become involved with, and begin to integrate the HIS into their daily work routine. Overall, the leader in support of the HIS understands the impact that this new healthcare information technology has and may increasingly have on healthcare delivery, while also understanding how to manage this impact[11,17,22]. Physicians within the US have been found to be more likely to adopt and integrate the HIS into their practices if there exists strong, committed, internal backing to do so[22].

Organizational Structure Change

While HIS change the ways in which medical records are recorded and stored[12], they can also have a significant impact on the organizational structure of a healthcare setting. Overlooking this promotes failure[3]. In fact, the organizational nature of HIS implementation is in some cases more significant than its technical components[17]. HIS can change the working relationships between staff, physicians, and other healthcare professionals[3]; with potential for a positive effect on the ways in which healthcare staff interact with one another, provide health care, maintain organization, and carry out their daily work routines[12]. The impact on the organizational structure, then, must be understood prior to implementation in order for the HIS to be a success[12].

HIS can conflict with the existing organization of the healthcare setting, especially when the HIS has been instituted without provider and staff input on design[23]. Poor HIS design can lead to failure in implementation due to systems that are not practical for the daily functioning of the clinics[2,3]. A well-designed HIS, then, will be considerate of its users and their time constraints[3,7,16]. Poorly designed HIS can lead to user dissatisfaction and feelings of being forced into changing their clinical structure and routine based upon a system that will not complement their practices. The users must be the driving force behind changes that take place within the clinical setting to ensure they are not threatened by them. There is a critical relationship, then, between organizational and technological changes[24].

Technology

A successful HIS does not, and cannot, spur change within healthcare settings. Instead, healthcare professionals using the HIS are the driving forces leading to success as well as failure in many cases[2,17,23]. In other words, technology facilitates but does not in itself bring about change. The healthcare professional, then, is the critical factor in achieving a successful HIS. Those using the HIS must be dedicated to making it work, and be strong leaders within their practice to aid the transition from paper-based medical records to electronic[5]. HIS must promote the creation of new opportunities in improved patient care[17], and success in the technological components of the HIS does not in itself guarantee successful implementation.

However, healthcare sites must first have the necessary technological capabilities and infrastructure to begin the implementation process[6,20]. Many use computers for billing only[20]. This is an especially important consideration in small practices, which have varying levels of available technological infrastructure[6,11].

With HIS, as with medical records in general, security and confidentiality are critical considerations which must be adequately addressed[5,8,10,11]. In practice, ensuring patient confidentiality using HIS can be more complicated that with paper-based records. With HIS, questions arise as to who should have access to specific sections of the patient chart and under what circumstances access should be granted[7].

The lack of standardization in terminology used in HIS is a major hindrance to successfully implementation. Terminology for technology must be standardized to ensure the meaning of the terminology, and in effect allow for a standard for of communication on HIS[7,11,16].

Lastly in regards to technology, some physicians have noted the need for a paper back-up system to their medical records because they did not place their trust in the computer's ability to safely store their data[12].

Training and technical support

HIS are not implemented simply because they have been acquired and installed[17], nor should the implementation be the overarching goal[11]. Such healthcare information technology cannot work without dedicated healthcare professionals who have had the opportunity to receive the education and training necessary to use the HIS and more easily integrate it into their unique setting. Furthermore, follow-up training and on-site support are good steps to ensure that users, having differing levels of computer skill, become comfortable with the software and use it successfully. Historically, focusing exclusively on the technology involved in implementing HIS has led to failure[23]. As noted in Lorenzi and Riley[23(p116)]:

> "Technical challenges still exist; they always will…[However,] too many technically good applications have failed because of sabotage by users who like the old ways in which things were done."

Furthermore, technical support may be most beneficial if received from multiple members of the practice itself. Internal sources of technical assistance have a strong

understanding of the individual comprehension levels, and would thus be better equipped to train providers and staff[12]. Regardless of who makes themselves available to provide training and assistance, the assistance offered must yield good user understanding of the HIS and data entry into the system. Data entry within difficult-to-use HIS is a major barrier to successful implementation due some healthcare settings finding it too difficult to allocate the necessary time[19].

Sociotechnical Approach

The sociotechnical approach to successfully implementing HIS within the clinical setting emphasizes that healthcare systems themselves must be the initial focal point. The installation of the HIS is only one step in the process of becoming a successful electronic registry. This approach stresses that the design of the HIS must be formed around the unique needs of the clinical setting[3,20,22]. There is no standard set of technological and/or organizational problems to be solved. Each setting poses unique difficulties in implementation[3], and elements determining success and failure are relative to each site. There is not a formula for successful implementation. Success, as seen by the sociotechnical approach, results from a thoughtful, well-planned combination of traditional office procedures and the new HIS elements. This is best accomplished in stages, at the pace appropriate for the each site, which allows the users to become accustomed to this change in the office environment[3].

Viewed from the sociotechnical approach, HIS integration is treated as a process, or a journey, that is determined by the specific needs, problems, goals, and overall uniqueness of each setting[1,24]. The sociotechnical approach, then, gives attention to the social, or human, variables that have a significant impact on the success of HIS. Berg[24] notes that sites respond differently to the introduction of HIS due to differences in clinical leadership, practice environment and finances. In general, Berg[24(p146)] holds that there are no prescriptions for success, only "insights." This is an integrated approach demonstrates that technical and social considerations are intimately linked[3].

As such, the sociotechnical approach mandates that the HIS be focused on the health professionals using the registry. Users should be involved with the design of the HIS, which will in turn provide them with a better understanding of how the HIS works and how to use it to its fullest potential[3,19]. This level of user involvement will help foster

increased, long-term support for the HIS among its users. Importantly however, the data collection components of the HIS must not become impractical in light of user input[3]. In other words, the users must be reminded that a simple HIS, or one which contains data collection components pertinent to the improvement of patient care and evaluation of quality improvement efforts, is a quality HIS.

This approach does not treat the current, traditional state of clinical healthcare as unorganized and in need of repair, but instead attempts to compliment and strengthen areas of patient care which already work well. The sociotechnical approach does not mandate that the electronic medical record be used instead of the traditional paper medical record. Instead, HIS is treated as a tool which has the potential for significant improvements in the quality and accessibility of the patient record, monitoring health status, and measuring quality improvement efforts. In the sociotechnical approach, the HIS compliments existing strengths and abilities within the clinical setting, and does not attempt a high-tech replacement. Any transformation in healthcare delivery occurs in conjunction with the existing skills, methods and positive approaches to patient care already present[3].

TOWARD SUCCESSFUL HEALTHCARE INFORMATION SYSTEMS

Summary

The complexity of the problems surrounding the implementation of HIS must not inhibit the benefits made possible to patients. Improved patient care is a uniting goal among diverse healthcare professionals that can help ensure successful HIS integration[11]. The main challenge in many cases lies in determining the best way in which to incorporate the HIS into the clinical practice. This issue is unique to each clinical setting[12].

Again, success is relative in HIS implementation. What defines success at one site may differ from what defines success at another site[23,24]. Some sites may wish to cut costs, others may wish to reduce time in data retrieval, others may focus only on improved patient care, and some may hope for all of these and more. No one factor alone will ensure success, which is in itself an evolving concept apt to change with time and HIS use. Overall, barriers to implementation are something to be adapted to, and not necessarily overcome[24].

The goal of HIS is not implementation in itself, but the establishment of improved patient care through improvement in the quality, accessibility, and usability of data[1]. Improved patient care must be actively sought[22]. Tsai and Starren[10] note that any new healthcare technology must be effective especially in the sense of cost and perhaps most importantly improved patient care.

Concluding comments on an integrated approach to HIS implementation

Within the literature there are two main inconsistencies which make it difficult to generalize findings on HIS implementation. First, there is little consistency in the contexts in which research into HIS implementation takes place. Some research takes place within small, private practices; other research within large hospitals, networked clinics and healthcare systems. This lack of consistency may be a significant factor in the varied findings on what determines success and failure in HIS. It will be most beneficial for future researchers to collaborate and concentrate on select healthcare settings to attempt to uncover common problems. Second, the available literature covers numerous types of HIS which are being implemented. Each HIS is different in its style and complexity, and offer unique challenges. Addressing both of these inconsistencies will greatly improve the quality of literature available on HIS.

Making use of both the critical factor approaches (focusing on usability, leadership, organizational structure and changes, technology, and training and technical support) and the sociotechnical approach, which is critical of focusing on specific factors of success and opts instead to uniquely examine each situation, may provide enhanced changes for successful HIS implementation. It may be a disadvantage for the sociotechnical approach to overlook factors which are persistent barriers to implementation. Similarly, it may be a disadvantage for critical factor approaches to focus on a single or select few obstacles. A combination of approaches is most appropriate; one which takes into account the historic problems encountered in HIS implementation and the uniqueness of each attempt at implementation. Each clinical setting must be viewed as unique in its working environment, needs and abilities. However, the available literature should be used by public health employees to gain a strong background and increase their chances for successful implementation; and in

effect increase the potential for improved patient care through improved patient medical records.

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