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Human Factors Predicting Failure and Success in Hospital Information System Implementations in Sub-Saharan Africa

Frank Verbeke[a,b], Gustave Karara[a], Marc Nyssen[a,b]

[a] *Department of Biostatistics and Medical Informatics, Vrije Universiteit Brussel, Brussels, Belgium*
[b] *Regional e-Health Center of Excellence, University of Rwanda, Kigali, Rwanda*

Abstract

From 2007 through 2014, the authors participated in the implementation of open source hospital information systems (HIS) in 19 hospitals in Rwanda, Burundi, DR Congo, Congo-Brazzaville, Gabon, and Mali. Most of these implementations were successful, but some failed. At the end of a seven-year implementation effort, a number of risk factors, facilitators, and pragmatic approaches related to the deployment of HIS in Sub-Saharan health facilities have been identified. Many of the problems encountered during the HIS implementation process were not related to technical issues but human, cultural, and environmental factors. This study retrospectively evaluates the predictive value of 14 project failure factors and 15 success factors in HIS implementation in the Sub-Saharan region. Nine of the failure factors were strongly correlated with project failure, three were moderately correlated, and one weakly correlated. Regression analysis also confirms that eight factors were strongly correlated with project success, four moderately correlated, and two weakly correlated. The study results may help estimate the expedience of future HIS projects.

Keywords:

Hospital information systems; Biomedical technology assessment; Computer systems evaluation

Introduction

HIS implementation has gained momentum in Sub-Saharan Africa in the past decade. In the period from 2007 to 2014, the authors participated in the implementation of the open source OpenClinic GA HIS [1] in 19 hospitals in Rwanda, Burundi, DR Congo, Congo-Brazzaville, Gabon, and Mali. Many of these implementations have been successful, but some of them turned into failures. Introducing HIS proved to be a complex process. There was no single standard pathway to successful implementation. Sometimes what failed in one health facility seemed to work very well in another one. In the beginning, many solutions had to be discovered by trial and error. Nevertheless, at the end of a seven-year implementation effort a number of risk factors, facilitators, and pragmatic approaches related to the deployment of HIS in Sub-Saharan health facilities have been identified. These elements have been categorized in the following classes:

- Infrastructure
- Patient administration
- Financial information management
- Reason for encounter and diagnostic coding
- Medical record management
- Lab information management
- Medical imaging
- Reporting and statistics
- Systems integration
- Project management issues and human factors

Many of our findings were in line with earlier publications that shed light on isolated aspects of health information system issues [2,3,4,5] and environmental country-specific problems [2,6,7]. Many of the issues that were encountered during the OpenClinic GA implementation process were not technical, but could be brought down to human, cultural, and environmental factors. Although such issues were frequently irrational and hard to solve, they seemed to be fairly predictive in determining the success or the failure of a project. In order to formally evaluate the predictive value of these human factors in our HIS implementations in the Sub-Saharan region, a retrospective, descriptive, and semi-quantitative study has been set up.

Materials and Methods

In the course of the 19 HIS implementation projects, implementation logbooks have systematically been kept that document a wide range of problems that arose, solutions, and workarounds, as well as the results that were obtained from implementing the solutions. Analysis of the logbooks—which included feedback from the local project managers in the 19 health facilities—resulted in the identification of the aforementioned 10 different classes of issues. The *Project Management Issues And Human Factors* class consisted of a list of 14 factors that could potentially be related to project failure and 15 factors that were potential candidates for predicting sustainable implementation success.

A global project implementation success score ranging from 0 (complete failure) to 5 (complete success) has been awarded to each of the 19 health facilities in our research. This score was derived from the level of agreement expressed by the hospital management staff and an external evaluator with a series of six statements ranging from 0 (completely disagree) to 5 (completely agree):

1. All goals which have been set out in the project scope have been achieved.
2. All project results have been delivered in time.
3. All intended users have been trained and are using the system.

4. The health information system implementation contributed to the improvement of health facility productivity.
5. The health information system has contributed to quality improvement of health care services.
6. The health facility is able to self-support post-project operational costs related to the health information system.

For every health facility, a score was then allocated representing the relevance of each of the 14 failure and 15 success factors. Scores ranged from 0 (irrelevant) to 5 (of highest importance) and the scoring of each factor was the result of a consensus between local health facility management and an external implementation evaluator. An average *risk level* score was then calculated for each health facility based on the average failure factor scores that were previously allocated. Similarly, the average score for the success factors was called the *opportunity level*. Finally, correlations were calculated between individual factors and project success scores.

Results

Implementation Failure Factors

Several authors have published extensive lists of potential pitfalls and failing factors for HIS deployment in developing countries. In 2002, Heeks [8] drew a rather pessimistic view of the health informatics landscape in the developing world mainly based on a perceived mismatch between information systems design and local user actuality. In our HIS implementations, we specifically tried to address issues related to such implementation gaps. Failure factors identified in our research substantially differed from Heeks' and other authors' [4,5] observations. What follows is a tabular summary of a number of factors that could be predictive for eventual project failure (Table 1). Predictive values show the correlation *r* with global project success and the *p*-value for the F-test on the regression with a confidence level of 95%. Significant correlations below 0.60 are labeled as having *low* predictive value, between 0.60 and 0.75 *moderate* predictive value, and above 0.75 *high* predictive value.

Table 1 – Project failure factors evaluation.

Failure factor	Description	Predictive value
1. Unclear goals	When no clear definitions of an intended outcome exist, measurement of success becomes extremely difficult. False and unrealistic user expectations are very likely to generate a perception of project failure.	r = 0.70 p<0.001 moderate
2. Absence of a project champion	Project champions are extremely important for aligning user behavior to set out project scope. Absence of a project champion often leads to disinterest and lack of user motivation.	r = 0.70 p<0.001 moderate
3. Resignation to poor health service quality	Hospital management resigning to the poor health status of patients and accepting inadequate health care practice are bound to fail in implementing information systems. Implementations can only be justified by health services improvement.	r = 0.81 p<0.0001 high
4. Psychological factors	Initial, often irrational user resistance and physician skepticism are predictive for slower implementation progress.	r = 0.78 p<0.0001 high
5. Organizational culture and silo mentality	Health facilities composed of individual relatively autonomous departments with minimal perception of system-wide collective goals carry a risk of fractional implementation. Lack of trust can also play a pernicious role.	r = 0.76 p<0.001 high
6. Resistance to change and power shifts	Documented resistance to change based on fear of losing a job or an advantageous position are often present in insecure working environments. If no measures are being taken to address such issues, partial or total project failure is more likely to occur.	r = 0.74 p<0.001 moderate
7. Time	Unrealistic implementation timeframes are bound to fail. Another time factor relates to the fact that information and communication technology (ICT) tools should never lengthen the time needed for performing routine operations. Systems that reduce users' productivity will rarely survive.	r = 0.90 p<0.0001 high
8. Poor technical assistance	In several sites, perceived technical assistance quality was directly correlated with overall users' system appreciation. Effective technical support is key to information systems being seen by users as dependable working instruments.	r = 0.80 p<0.0001 high
9. Insufficiently skilled staff	Health facility staff with extremely low ICT skills are somehow predictive for failure as they add an	r = 0.59 p<0.01 low

	additional burden to training and user assistance, and increase funding requirements.	
10. Insufficient training	Inadequately trained users provide inadequate results. Although such logic does not apply to ICT-based systems exclusively, often ICT-training inadequacy is being translated into excessive system complexity. Additionally, continued training should address staff turnover.	r = 0.77 p<0.0001 high
11. Discontinued follow-up	Users being left alone after initial start-up training creates a sense of disinterest. Result-oriented implementations must address the need for individual follow-up.	r = 0.90 p<0.0001 high
12. Poor mapping on prevailing practices	ICT tools which are poorly mapped onto existing routines and practices will be abandoned in the end. If users fail to find personal interest in developed instruments, they will not use them.	r = 0.27 p = 0.26 NA
13. Perceived complexity	Modules that contain a high level of perceived complexity will frighten many users and induce unnecessary resistance to change. ICT skills being scarce in Sub-Saharan Africa, complicated systems must be avoided.	r = 0.77 p<0.001 high
14. Low user satisfaction	Low user satisfaction in the course of project implementation must always be considered an alarming element. In the case of clear user dissatisfaction, ongoing implementation should be reconsidered.	r = 0.97 p<0.0001 high
Global risk level	Average score for all of the above failure factors.	r = 0.95 p<0.0001 high

Based on our study set, 9 of the 14 factors were strongly correlated with project failure, 3 factors were moderately correlated, and 1 factor had low predictive value. The evaluation of factor 12 (poor mapping on prevailing practices) produced no valuable output because too few health facilities faced this kind of issue. The calculated global risk level score demonstrated a strong, statistically-significant correlation with project success (Figure 1).

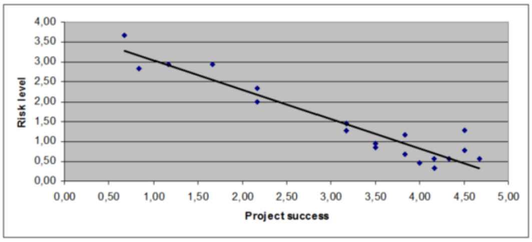

Figure 1 – Risk level and project success regression.

Implementation Success Factors

Similar to the identification of failure risks, a list of elements that increase the likelihood of successful project implementation have also been isolated. A number of such factors has already been described by Hendricks [4] based on a review of 31 reports on electronic health records implementations in developing and developed countries. In our study results we found that many of the factors in Hendricks' report did not fit the Sub-Saharan healthcare reality. What follows is a tabular summary of a shorter list of success factors that applied to our own research experience (Table 2).

Table 2 – Project success factors evaluation.

Success factor	Description	Predictive value
1. Broad staff enrollment	When the majority of users at all levels of the health facility have the feeling of participating in the implementation effort, HIS can develop beyond the stage of being a management whim.	r = 0.68 p<0.01 moderate
2. Clear communication	Clear, broad communication of the goals and the potential impact of the new technology on work organization helps to cope with resistance to change and distrustful mindsets.	r = 0.85 p<0.0001 high
3. Realistic timing	Timing should be realistic enough to address reasonable stakeholders' expectations. A well-planned implementation with a feasible schedule assures better synchronization between different projects' tasks.	r = 0.80 p<0.0001 high
4. Progressive change management	Big bang implementations where massive business process change is pushed through complex organizations, such as health facilities, is a dangerous practice. Gradual and progressive introduction of new modules often appears more successful.	r = 0.70 p<0.001 moderate

5. Incentives	Motivation of HIS users in the form of an official recognition, a small reward, or even a simple pat on the back have been found mainly in successful projects.	r = 0.43 p<0.07 Not significant
6. Business process reengineering ability	The ability of a health organization to cope with necessary transformations of business processes that get in the way of information systems implementation is important for achieving the best productivity improvement.	r = 0.81 p<0.0001 high
7. Stakeholder consensus	Optimally, HIS implementation must be in line with the goals of all stakeholders. Reorientation of project scope must therefore always be based on stakeholder consensus.	r = 0.75 p<0.001 high
8. Holistic approach	Systems that efficiently integrate information from different departments better contribute to global business targets, such as generic patient health status improvement and hospital productivity.	r = 0.82 p<0.0001 high
9. *Quick wins* implementation	*Quick wins* can constitute an essential step in bridging the start-up gap between systems' potential and users' mistrust. They can greatly motivate users for continuing to invest in a project.	r = 0.91 p<0.0001 high
10. Sufficient and continued training	Users' needs for training must always be considered seriously. Users who feel comfortable with the system's operating procedures show a more positive attitude towards the project, resulting in better outputs.	r = 0.68 p<0.01 moderate
11. Clinician and ICT staff intermediaries	The presence of health IT experts can resolve many communication errors between IT technicians and clinical staff pro-actively. This can reduce frustration and inadequate allocation of development time.	r = 0.54 p = 0.02 low
12. Consideration of prevailing practice	HIS should never dictate users' business processes, but rather adapt to the actuality of the activity they support. Doing so can transform these systems into highly valued instruments that facilitate work.	r = 0.56 p = 0.01 low
13. Adequate technical assistance	Many users don't mind facing technical problems once in a while, as long as these can be quickly and effectively addressed by technical support staff. Unresponsive support staff can compromise project survival.	r = 0.85 p<0.0001 high
14. High measured user satisfaction	Obviously, a high level of user satisfaction being measured in the course of project implementation is a strong indicator of important user concerns being appropriately addressed.	r = 0.94 p<0.0001 high
15. Perceived user-friendliness	Simplicity and suitability of user interfaces for performing frequent tasks are generally perceived as user-friendly, which improves user acceptance and reduces initial resistance to change.	r = 0.69 p<0.01 moderate
Global opportunity level	Average score for all of the above success factors.	r = 0.91 p<0.0001 high

Regression analysis confirms 8 factors are strongly correlated with project success, 4 factors have a moderate correlation, and 2 factors have a weak correlation. The average opportunity level also strongly and significantly correlates with project success (Figure 2). For factor 5 (incentives), no statistically significant relationship to eventual project success can be demonstrated.

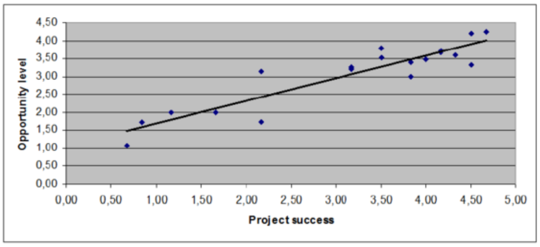

Figure 2 – Opportunity level and project success regression.

Conclusion

The developed failure risk assessment scheme confirmed, to a large extent, the relevance of the failure risk factors we extracted from many interviews with several hundred health facility users. As expected, the user-oriented nature of the OpenClinic GA HIS led to results that were substantially different from data that had been previously published by other authors [4,8]. This mainly resulted in a low predictive value of risk and success factor 12 (mapping on prevailing practices) in our study sample.

Although every health facility constitutes a specific case and no absolute information can be derived from the listed risk and success factors, they may offer some grip for estimating the potential expedience of future HIS projects that are being considered.

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Address for correspondence

Frank Verbeke, MD, PhD
Department of Biostatistics and Medical Informatics
Vrije Universiteit Brussel
Laarbeeklaan 103
B-1080 Brussels
Belgium
frank.verbeke@vub.ac.be