Sustainability of computerised Health Information System Implementation in Developing Countries: a Meta Analysis of Evidence

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Abstract

A Systematic review of studies of computerized HIS in developing countries was carried out. A realist review method was chosen to refine the questions, develop pa framework and synthesize the findings.Complexity and context of internal and external environment are key to sustainability of computerized HIS in DC. HIS system that are aligned to the technical environment of the context(country) and those that can be localized (through adaptation) will be sustainable, as long as their product has currency to the users.

Keywords: Sustainability, health information system, developing countries\, frameworks

Introduction

Information technology (IT) failure has been documented in the literature in Industrialized Countries (IC) for some time. It has been estimated that one to three fifth of IT projects do not attain major goals or have undesirable outcomes (termed partial failure) and one fifths to a quarter where it was never implemented or immediately abandoned (termed total failure), leaving only a few with success[1]. (Heeks, 2002). In the health sector few major disasters attract attention, many are not publicly discussed due to their political nature.

Such disasters also take place in developing countries (DC), in some cases in some of the poorest countries in the world. The impact can be large in economic terms. The failed hospital information system in South Africa cost the province, a total of 20.2 million pounds, accounting for about 3.8 % of the total health and welfare budget[2] . It also brings into stark contrast the opportunity cost, when these countries, cannot afford, proven , highly effective public health intervention such as immunizations. These countries, need to even resist such investments till there is clear evidence of its effectiveness, or at least build in good evaluations into the contract[2].

The identification of an IT failure, is not very clear, as it is a subjective judgment. One of the key dimensions is the timing, as today's success can be tomorrow's failure and vice versa[1]. Of particular interest, therefore is the category called " sus tainability failure" where the implemented HIS results in a successful handover, which is then abandoned later, by the organization. In most ICs, the resources and know how exists to resurrect or modify the problems and such failures do not result in publicity. However in the case of DCs, design and actuality gaps are wider and immediate " cover up" does not occur, leading to a "strech" , with provides the opportunity for a better understanding of the characteristics and factors that take place[1].

The motivation for the paper is the emergence of commercial interests in computerized HIS in DC. Most of the poorer countries, depend on development partners to provide such investments, which is eventually supplied on a commercial basis[3]. In addition, relative to the mid and late 1990's there is more literature in the public domain, of this phenomenon.

The paper is organized as follows. First the conceptual and theoretical understanding of sustainable HIS will be discussed in relation to other similar concepts. A review of theory from the will be used to develop a framework for conducting a meta analysis. A method based on systematic review will use a purposive sample of case studies, both from the published and "grey" literature. The studies will be analyzed to understand the temporal effects and seek a better understanding of sustainability of HIS in DC.

Theoretical concepts of sustainability and HIS sustainability.

Early work in development aid literature identified sustainability to relate to the capacity of recipients' (countries and institutions) need to be self reliant as a consequence of donor aid [4]. The sustainable solutions have been identified as investments that continue to provide a return. The term return is defined in a broader sense , to include social, educational ,[and health] returns[5].

In the field of HIS, many of the definitions for the term , sustainability come from public health[6] and has been used in HIS [3] .

" Sustainability implies user organizations ability to identify and manage risks that threaten long term viability of HIS following the withdrawal of external support "[3]

An important feature of these definitions is the recognition that HIS (and the institutions that install HIS) face risks of change. If one could separate the technology from the organization, the former is more prone to change than the latter. In most cases public institutions that install HIS, produce benefits by the nature of their product, that is health care services. Therefore it can be argued that HIS sustainability also needs to consider the viability and long term benefit of the technology towards health care.

A closely related concept to sustainability in the development literature is " capacity building" . The following statement illustrates the connection lucidly

" we would go further to state that it [capacity building] should enable programme execution independent of change of personalities, technologies, social structures and resource crises…it implies developing sustainable and robust systems" [7]

In the literature, the concept of capacity building seems to be used interchangeably with institution building, institution strengthening and development management. Institutional capacity, has been identified as a vital ingredient in providing effective service[7].

Methods

Realist reviews are relatively a new strategy for synthesizing research findings that are qualitative. Instead of seeking representation and generalizability, sought in positivist research, realist reviews seek to unpack the mechanisms of "how" complex programs work or why they fail in particular contexts and settings[8]. It answers the question of " what works for whom in what circumstances and what respects" [8]. Therefore this method is appropriate to address the aims set out in the introduction. As it is a relatively new method, the methods for data gathering and analyses are described , relative to the steps of the method (table 1).

Table 1. Methods of realist review

Realist review methodology steps	Description of Methods followed
Step 1. Clarifying Scope a)identify the review question (nature /context) b) refine purpose of review c) articulate key theory	Scope of the review was limited to HIS in DC. The nature of the study is a systematic qualitative meta analysis, using a realist review method. Initial purpose was identified as a comparison: how does computerized HIS work (or fail) in different settings? This was refined after initial synthesis(see below) A literature search on " sustainability" was conducted. Three theories were identified that have relevance to the purpose.
Step 2. Search for Evidence a) exploratory search to get a feel. b) progressive focusing to identify key theory and refine inclusion criteria c) purposive sampling and "snowball" sampling	Literature on HIS in DC over the last two decades was known by author. Progressive focusing occurred by reading key articles, and the concept of " sustainability failure" used as inclusion criteria. Based on framework for review (Figure 1) purposive sampling was used to search to populate it . Grey literature was included.
Step 3. Appraise primary studies and extract data a) use judgment: relevance and rigour b) develop data extraction forms and notation devices. c) Extract different data from different studies to populate framework.	Judgments made to access and use studies were based on peer reviewed publications. Grey literature was included when the author had firsthand assurance of authenticity. Data extraction from documents were used to develop case studies and comparative tables (see results)
Step 4: Synthesize evidence and draw conclusions. a) allow purpose to drive synthesis. b) use contradictory evidence. c) present conclusions	Initial synthesis from key articles, was used to refine the purpose to " How does long term sustainability of computerized HIS in DC unfold? What are the key characteristics that affect failure and success?" Contradictions were sought in the studies. Conclusions are presented as a set of principles that guide, not rules that govern the phenomenon.

Results

As a realist review is an iterative process, the results will be presented in the sequence of evidence gathering, synthesis, further extraction of evidence from studies and synthesis.

<u>Evidence on theory</u>

The literature review identified three theories of relevance to the purpose of the review.

1. IS sustainability as a design-actuality gap[1].
2. Systemic capacity building framework[7]; and
3. Framework for strategy in sustainable development of institutions[4].

The key ideas, concepts from these theories were extracted to build the framework for the study and search for evidence (step 2b).

Building a theoretical framework

Complexity is the key issue, and it is inversely related to sustainability[4]. It can be decomposed to internal and external dimensions, based on concepts for strategic planning, that identify complexity of internal processes and environmental hostility[4]. Pettigrew and Ferlie[9] has argued that useful research on change should involve the constant interplay between ideas about the context of change, the process of change and the content of change. Analysis of the context of the system, can be differentiated to an 'inner' context and an 'outer' context. The former refers to the ongoing strategy, structure, culture, management and political process of the organisation itself (eg. the Department of Health and/or Ministry of Health) and the latter includes the national economic, political and social context which is the wider public sector and the political milieu of health systems (eg. the National and/or Provincial Governments) in these countries.

Heeks[1] reviewed IS failure in DC and identified a number of dimensions by which one could understand the reasons. He proposed , using the Leavitt framework, that a design – actuality gap exists with tools, process, people and structure, is implementing IS in DC. Using the example of project implementation in India, Potter & Brough [7] proposed that within a systemic capacity building framework there exists four key components , a) tools; b) skills; c) staff and facilities; and d) structure, systems and roles. They state that it is easier (and requires less time) to build capacity in the first two, than the latter two components. A framework for evaluating sustainability of HIS in DC needs to include the concept of time. Our initial definitions of sustainability emphasized the viability over time.

Based on the above theories, a framework for sustainability analysis of HIS in DC was developed (Table 2). Studies were searched to populate the framework (step 3c).

Framework for evidence review.

Table 2: framework and studies

	Content and Process	Context (environment)
Internal Complexity hi	Northern Province HIS [2]	Northern Province HIS
low	New Hope HIS[12]	Samoa HIS
External complexity hi	FHSIS[11]	FHSIS
low	Tanzania HISP[3]	India[15]

Exemplar of a case study for longitudinal analysis

In 1989, the Department of Health in the Philippines embarked on to provide a single comprehensive system of information for all health preventive programs. The FHSIS design called for provision of one or more computers at each Provincial health office (PHO, a total of 67) and City Health Office (CHO). The viability of the FHSIS depended very heavily upon the computer processing scheme developed for the system[10] .

It was agreed that data processing using computers was necessary to enable, reduction of staff time in aggregating data, reduce time lag of reports from the field to the centre, and to have a database for further analysis[10]. A decision was taken that the lowest level of computerisation was to be at the Province and that an Information Distribution center would be established at Central level with a database that could be accessed by all relevant units in the DOH [10]. By 1993, there were numerous projects(both national and donor funded) and a number of stakeholders addressing issues of information systems. At this point, three different sections had different responsibilities for HIS, there was resultant ambiguity even among the DOH hierarchy as to the responsibilities for HIS in the DOH. Many had elements that were components of the original FHSIS or overlapped with the system[11].

A major re-organisation in Health services occurred in October 1991 with decentralisation of power, authority, responsibility and resources of certain agencies to the local government units, provinces, cities , municipalities and barangays. This resulted in the Provincial Offices, which were the key nodes for the computerized FHSIS, being under a different authority, the provincial governor. Their allegiance, with the DOH was severed.

Implementation of FHSIS had been planned to be completed by 1990, but by the end of 1993 though the computers were in place in all the provinces, many of the users in the DOH were disillusioned with the system [11]. Over the time that had been taken for the system to be implemented the needs of information of these units had changed. Since it was perceived that the system did not provide the information they required in a reliable and timely manner program managers in the DOH began to once again develop their own vertical systems of reporting to suit their requirements.

Through the period 1994-2002, a number of donor projects assisted, in strengthening the HIS in the country. The long time frame also resulted in availability of more sophisticated database environments for the DOH and the ability to develop technical skills at the central level. While the technical capacity now exists, there was no impetus for the provinces to improve the system. In 2005, the FHSIS still functioned as the official system , but with reports that were submitted as hard copies from province to DOH, with delays of transmission and with little utilization by users at local level.

Exemplar of comparative analysis of two case studies

These two case studies were selected, to look at similarities and contrasts within the framework. In both cases, the designs of the HIS was based on experience in IC. As the environment within a hospital, was expected (by the designers) to be very similar in terms of functions and processes in DC.

Table 3. Comparative analysis of Hospital Information Systems

	CIS system in Samoa	Hospital System in Northern Province South Africa
Purpose and context	A computerized Hospital information system, designed to improve clinical care and hospital management. Two main hospitals in country.	Computerization of Hospital Information in all 42 hospital in one province. To improve patient management and revenue collection
Project duration and period	1999-2001 (project still ongoing)	1998 - 2003
Design and development	Contractors for the donor driven project design on a specifications of an IC hospital	IBM contract terminated and subsequent contract given to another contractor
Internal environment (System implementation issues)	A number of promised sub – systems not delivered. No capacity in house. Trained staff leaves country. Synchronization and back up not functional. Reports not generated. Some basic core functions enabled (eg PMI). Long period of system not in use as no local technical support contract. Not used in hospital management	Most application programs not completed . however, some benefits seem by staff of the system. Others resist due to lack of training. System malfunctioning, due to poor infrastructure (power supply etc). Periods of shut down creates additional work for staff. Some increase in revenue collection, but overall management of hospitals not improved. Not used in hospital management
External environment (Project management and institutionalization)	DOH not in a position to carry out technical negotiations with contractors. Change of senior staff responsible. Insufficient resources to have maintenance contracts.	Different expectation of managers, contractors and users. Change of “champions and key staff at the province. Insufficient technical know how to institutionalize systems.
Long term developments	Donor support provided from 2003- onwards to resurrect system. Decision to replace with more suitable software.	Reluctance to give up project leads to second contract which is also a failure.

A number of other case studies were also chosen for the review. Reference these are made in the discussion .

Discussion

The purpose of the review was to understand how implementation of Computerized HIS in DC , can be successful. This aim was then revised in the process of the realist method used to how does long term sustainability of computerized HIS in DC unfold? What are the key characteristics that affect failure and success?

Theory inform us that factors such as complexity (both internal and external) , content, process and context influence long term sustainability. We looked at the evidence from actual case studies to further understand the phenomenon .

HIS in DC, and specifically computerized HIS (where the technology is key tool) is vulnerable to both internal complexity and external changes in the environment. Internal complexity was analyzed using two complex Hospital Information systems, that were designed with IC environments (of both users and infra structure in mind) in Samoa and Northern Province in South Africa (see table 3). This was contrasted to the New Hope HIS in a small rural hospital in South Africa [12]. In the latter case, success of implementation was linked the ability to local adapt the system. The technology used (ie software) was a universally available database, without the need for high level design skills. In addition, this project was backed up by a consortium that had long term experience in introducing the same tools in similar poor DC environments. The key points (principles) that were revealed were:

- Technology to be introduced to green field sites need to be comparable to the environment (in the country). Ambitious plans to “leap frog” development is not sustainable till the environment comes to

that level of development (as in case of FHSIS in 2005).

- Previous experience in introducing technology (HIS) and the ability to be flexible allows sustainability of HIS in DC [13].

Complexity is also created in HIS by the variety of health programs that have different motives and "rationalities" [14]. two longitudinal case studies , illustrate the issues. The FHSIS faced the pressure from different program managers , when it failed to provide the information they required. In the case of HISP in India, over the longer term the developers were able to negotiate their " niche" within other systems [15].

Key factors that influence such long term viability of projects especially in the area of primary health care and disease prevention HIS are:

The constant change of "sponsors" and "champions" for the system, due to the high turn over of senior staff in DC situations. This was well illustrated in the Andhra Pradesh case [15].

Most HIS systems designed to produce management information, to a higher level , have an inherent deficiency, in terms of sustainability as they do not have immediate or explicit health returns. This is compounded by the fact that, in most DC situations management decisions are not based on information. There is need for a long term investment in training and changing the processes in such situations for HIS to be used.
In summary, both complexity and context of internal and external environment are key to sustainability of computerized HIS in DC. HIS system that are aligned to the technical environment of the context(country) and those that can be localized (through adaptation) will be sustainable, as long as their product has currency to the users.

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