

Healthcare Information Systems Implementation Causal Mechanisms in Resource-constrained Environments

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Abstract

Background: The implementation of healthcare information systems has regained new interest among scholars, policy makers and governments over the past decades. This is as a result of undesired outcomes of the existing implementation processes which has produced outcomes such as lack of integration between existing systems, uncoordinated thus fragmented silo systems and many more. The implications of such outcomes have been that in most public healthcare facilities, medical information are either never captured, or captured incorrectly or ineffectively. Consequently, the retrieval of such information for decision making purposes at various levels of the healthcare system, becomes a challenge.

Objectives: This paper sought to establish causal mechanisms and context-based mediators that influence the implementation of healthcare information systems in public healthcare facilities in resource constrained environments. As such having negative implications of the delivery of healthcare services to people in need.

Methods: A case-study strategy approach was employed using a critical realist methodology. Data collection was done through semi-structured interviews and document analysis.

Results: The findings in this paper indicate that context-based mediators such as leadership and management, maldistribution of resources and health policies have enabling and impeding effects on the implementation of HISs for public healthcare service delivery. Further the results of this paper highlight generative mechanisms such as misinterpretation of policies from paper to practice at operational level of healthcare systems of policies and strategies trigger causal effects that may generate the outcomes experienced in public healthcare service delivery process.

Conclusions: The results in this paper suggests that mediating factors and generative mechanisms with inhibiting causal powers in the implementation of healthcare information systems requires more focus during the pre-implementation phase.

Background

Integrated healthcare service delivery has been a sought after aspect in healthcare systems around the globe for a period of time. The integration of healthcare services involves adequate organization and management of healthcare data and information that enables a population to gain access to quality healthcare services they need. Subsequent to this need, many healthcare systems have turned to information systems as an enabling tool for the management and organization of healthcare services. Information technologies has long been perceived by many as an operational efficiency enabler in an organizational context including in the healthcare sector [1, 2]. And as a result of this notion, technology has become an integral part of healthcare service delivery in many healthcare systems around the world. Regrettably, many countries have yet to optimally achieve the return on investments made by purchasing and implementing these systems. In the public healthcare sector, the implementation of these

information systems have not quite yielded the desired results that most governments hope for. This is more prevalent in developing countries where resources are constrained exacerbated by the growing burden of communicable and chronic diseases such as HIV/AIDS and tuberculosis. The implementation of the technological interventions in the public healthcare sector in developing countries have often been associated with challenges such as poorly coordinated systems, implementation done in a silo ad hoc manner resulting in fragmented systems with limited interoperability and software re-use, and plethora of small pilots that are not scalable [3,4, 5]. These has resulted in inadequate healthcare information management capabilities.

The researchers deduce that the causes of these challenges are not purely logistical but also linked to the gaps in the evaluation of the implementation process of technological interventions adopted to facilitate healthcare service delivery. The paper argues that unless the challenges are adequately addressed, it would also be highly unlikely for healthcare systems in developing countries to realise the return on investment for this interventions. The implications of this is that the implementation and subsequent use of interventions such as healthcare information systems (HISs) would yield undesired outcomes in the efforts of improving the quality of healthcare services. These would hinder the healthcare sectors' transformation agenda of with dire consequences the economies and overall democratic stability of a country. With this paper the researchers aim to bring forth the importance of critical assessment and evaluation of the implementation processes of healthcare technological intervention in resource-constrained environments. The researchers argue that decision and healthcare policy makers pertaining to technology intervention should make considerations for context-based mediating factors that have causal powers that may enable or inhibit the implementation and subsequent optimal use of interventions such as HISs.

The researchers here argue that decision makers must look beyond just the context based mediators but also at generative causation, where recognition is given to underlying factors in the implementation variances of similar technological interventions in different contexts. This study adopts [6:2] description of the term implementation stating that it is *"the process of putting to use or integrating new interventions within a setting"*. This paper therefore views the implementation of HIS as the act of putting to use (infusion) of HIS into the work activities of healthcare practitioners in a healthcare setting. This would involve the act of defining how a particular technology should ideally be designed and developed to fit its purpose for use and context in which it would be implemented. This whilst ensuring that the technology is operational and is optimally used by the end-users. To achieve this, hospital and healthcare managers must insist on continuous monitoring and evaluation of the HISs to assess whether the systems are performing for their intended purposes. The assumption is that the outcomes of such actions if done adequately would be to eradicate challenges of inefficiency in data collection, storage and sharing within a healthcare system. Healthcare systems would be able to efficiently and effectively identify poorly and fragmented systems and lack of interoperability between existing systems. Contrary to this would be the negative implications these challenges would have on the delivery of healthcare services to the population who needs it.

There has been a renewed interest globally of finding appropriate solutions to the implementation challenges that mar healthcare systems in resource-constrained environments [7, 8, 9]. In many of scholarly studies done on the implementation of information system in the healthcare sector, the focus has always been on just factors that enable or inhibit the process. Therefore in this paper the researchers sought to establish generative causations of factors that may trigger causal powers with enabling or inhibiting effects in the implementation process the implementation of technology interventions in healthcare settings in resource-constrained environments. The aims and objectives of this study are carried out in a South African context of public healthcare facilities in the predominantly under-resourced communities. The question therefore, which the paper sought to address was: *what are the generative mechanisms affecting HISs implementation in public healthcare facilities in resource-constrained environments?* The assumption is that the generative mechanisms within the implementation process of these technological solutions could impact the integration of these interventions into the daily work activities of healthcare practitioners. Consequently, this hampers the chance of optimal usage of HIS to improve the healthcare activities (clinical and administrative) in the healthcare service delivery process outcomes [10].

In South Africa, the District health information system (DHIS) is an example of a well-documented system in use in most public healthcare facilities. The system was developed and implemented for the purpose of routine data collection, capturing, storage, analysis and routine reporting [11, 12]. Although in its early use the system achieved its initial intended purposes, the growing burden of increasing population and subsequently increase in the demand for routine healthcare data and information exposed several shortfalls of the system such as the poor quality of data bottlenecks in the workflow in the delivery of healthcare processes [13]. The implications of such outcomes has been that much of the health care information public hospitals are either never captured, or captured incorrectly or inefficiently. Consequently, the retrieval of these information for decision making purposes at different levels of a health system has been a challenge for relevant stakeholders. Consequently, [5] argue that such cases resulted in the sector's failure to realize the return on investment of these systems. The intended purpose of HIS implementation in healthcare facilities is generally to improve healthcare service delivery in order to provide quality care to patients and be able to achieve healthcare equity. To achieve these goals, the core objectives of HIS such as to improve the quality of healthcare delivery, increase patient safety by reducing medical errors, strengthen the relationship between patients and healthcare practitioners and reduce cost in the health system must be achieved. [14] argue that to achieve these objectives would mean that the implementation process of such systems are adequately embedded into the work activities of the healthcare workforce.

Context-based factors in HIS implementation

The debate of factors that influence successful implementation of information systems (IS) has been around for many decades and as such it has been at the forefront of the IS field. The on-going debate has centred on the influence of the technical Vis-a`-Vis human behavioural aspects. [15] suggest that the implementation process is best dealt with from a technical perspective. Contrary to this argument, [16, 17]

argue that IS implementation depended on human behavioural aspects particularly the involvement of users in the process, the prototyping of the system and the availability of information analysis of the implementation and change agents in the process. As such for many years failures associated with the implementation of IS were associated with software and hardware issues [18, 19, 20] rather than the complexities of the changes to the end-users brought on by these systems.

In their study of implementation of interventions in healthcare settings, [10] suggests attributes of implementing an intervention. These attributes include understanding of the setting in which the intervention is to be implemented; acknowledging the complexities (from diffusion and dissemination to assimilation) of the implementation process in that particular setting; and positioning preliminary links amongst implementation concepts. Drawing from these argument the researchers conclude that there is a significant importance of gaining an in-depth understanding of the context in which the intervention is to be implemented. This include the understanding of the end-users and technical capability of the context. There are many scholars who have done studies related to factors that in some way influence the implementation of technology in a healthcare context. These scholars include [21, 22, and 23]. [23] stress the importance of understanding contextual issues surrounding technology adoption and implementation. Similarly, [24] argue that the selection of an implementation strategy, should involve more than just a focus on the technology to be implemented but also on the setting, end-users as well as the degree of inclusion and depth of analysis of the implementation concepts.

The papers' conceptual framework shown in Figure 1 illustrates the dynamics of healthcare information systems, the public healthcare sector and the environment. It showcases the correlation between the different aspects within the healthcare sector, including the components of a public healthcare system, the delivery of healthcare services, ISs providers and the various application of the ISs in a particular context. Based on the illustrations in the diagram, the paper argues that the effects of implementation activities can have positive or negative implication in the application of these system in the healthcare service delivery process. The outcomes of these effects are experienced by patients who receive care services from the public healthcare facilities, with the broader impact being on the country's health outcomes (desired or undesired).

The factors highlighted here are studied within the realms of critical realist ontology, with specific focus on the generative mechanisms that may possess causal powers that trigger specific changes in the healthcare service delivery systems.

Methods

Methodologies stem from a study's ontological and epistemological commitments. Employing a qualitative methodology, a nominalist's ontological stance is taken as the paper focuses on the realities of entities, generative mechanisms, structures and causal powers within the implementation process of HIS in resource-constrained environments. Epistemologically, the paper's stance is that of rationalism which deal with human moral reasoning and social constructs [16, 25]. The paper adopts the critical

realism paradigm as it addresses the 'epistemic fallacy' of both positivism and interpretivism. To this [9] suggests that followers of the two paradigms tend to assume that what exists is what is observed and experienced. However, in critical realism the emphasis is on the understanding of the existing association between the real, the actual and the empirical (stratified ontology) in a social world. In the context of this paper this would mean looking beyond what is experienced during and after the implementation of healthcare information systems in healthcare settings. The paper argues that this kind of understanding allows for causal explanations by postulating that mechanisms, social structures and the interrelations in varied contexts may cause the events and experiences of issues under investigation [26, 27]. Central to critical realism, is its methodology that focuses on the generative mechanisms that cause events that may or may not be observable [28]. In addition to this, [29:123] argues that at the premise of a critical realist methodology is the question "what causes events associated with the phenomenon to occur?" From the stratified ontology, it is in the real domain that generative mechanisms reside. [30:911] define generative mechanisms as "...causal structures that generate observable events". This mechanisms exist independently of the observable events but capable of producing patterns of events.

In order to understand and explain generative mechanisms of context-based factors of HIS implementation in healthcare settings, the study adopts [31] ontological stance of a critical realist. The author bases the stance on two sets of assumptions, (i) that an independent reality exists that incorporates dimensions and domains and (ii) that of a three level stratified ontology comprising of the three domains of reality; *empirical*, *actual* and the *real* as illustrated in Figure 1. The researchers believe that the stratified ontology of critical realism is key in its methodology that provides a roadmap for explanations of issues under investigations to take place. According to [32], critical realists believe that human knowledge (in this case empirical findings) captures a very small part of the broader and deeper reality of the phenomenon under investigation. As such there is a need for researchers to look beyond just the empirical data and in doing so, the [31] posits that researchers tend to engage in explanations to causal analysis. This brings forth the concept of generative mechanisms which [31] argues is an act where some process is held accountable for an observable event. For example in the case of this paper, poor quality of data, fragmentation of information, bottleneck of healthcare workflow are observable events within the healthcare system that are triggered as a result of certain processes.

Drawing on the stratified ontology and the concept of generative mechanism in critical realism the causal variability is HIS implementation and subsequent adequate use in healthcare facilities in resource-constrained environments is sought.

Critical realism methodology

In this section of the paper, the a description is provided on how a critical realist based methodology approach is applied to identify and characterise generative mechanisms and structures in the implementation activities of HIS in a healthcare setting. This mechanisms and structure trigger context-based factors that have implications in the infusion of HIS into healthcare work activities to facilitate healthcare service delivery process. To illustrate this, the paper adopts the [34] six stepwise framework for

data analysis in a critical study. Based on the framework, the first step involves the description of the events in the phenomenon under investigation. The authors posit that the identified events become the objects of inquiry (*ibid*). In the context of this paper this step involved the description of the case and unit of analysis which is the implementation of HIS for public healthcare service delivery. The study describes the role of HIS in public healthcare service delivery in a resource-constrained environment, its purpose of implementation as well as use. These later on become the object of inquiry in this paper. In the second step of the [34] framework involves the identification of objects that characterise the phenomenon under investigation. The key objects for this study would include the actors (people), institution and system that form part of the social structure with causal powers. This involved the identification of key stakeholder in the healthcare service delivery system including healthcare practitioners, policy makers, and management.

The third step in the framework involves the interpretation of empirical data or otherwise known as the abduction process or theoretical redescription. For this, the paper employs Activity Analysis and Development (ActAD) model Figure 3 as a theoretical framework used for the abduction process. The paper is guided by the underlying principles of the ActAD model including that (i) the object-oriented activity system in this case healthcare service delivery process which is taken as the prime unit of analysis and is viewed in relation to the other network of activities such as implementation of HIS; (ii) the second guiding principle is the idea that an activity has multiple voices. Interpreted in this study as an activity have multiple actors involved performing various actions. In the context of this paper includes healthcare practitioners, policy makers, managers and leader at various levels of the healthcare system all carrying out various activities. The third (iii) principle used is of the view that an activity system is an historical activity events that form over a period of time which is found to be true in the case of this paper. Healthcare service delivery in many countries is littered with historical activities that evolve over a period of time. The fourth guiding principle is the vital role contradictions within an activity system have as a source of change and development. In the case of these paper contradictions is evident in cases where perceptions such as that of implementation of HIS enabling efficiency in the delivery process has brought change to the manner in which technology is implemented and used. The final (v) principle guiding the analysis in this paper is the possibility of transformation and reconceptualization of the identified objects and motives [35].

The rationale for employing these ActAD model principles is that they are similar to critical realism in being relatively open with respect to particular methods, providing an overarching frame and conceptual tools of inquiry- they provide exploratory guidance rather than strict rules. In the fourth step of [34] framework, involves the identification of generative mechanisms that may explain the cause of observable events. This step is otherwise also referred to as the retroduction process. The authors classify the step into two categories (i) the interplay of objects and (ii) looking for micro-macro mechanisms. The paper interrogates the interplay of HIS implementation activities and the subsequent use to facilitate healthcare service delivery. [34] posit that the micro-macro mechanisms offer explanations to emergent behaviour in the phenomenon under investigation, whilst the macro-micro mechanisms give explanations to how the whole enables or constrain the various parts of the observable

events [36, 34]. Step five, presents the results of the retroduction process, the mechanisms are analysed, to find what mechanisms may explain the outcomes. [34] propose the forward chaining to understand the intentions or backward chaining to understand the results. For instance, in this paper, causes that may result in inadequate implementation and use are identified/determined, the study should therefore look for mechanisms that led to the outcomes. This step prepares for step six where a decision is made whether a mechanism are satisfactory.

The sub-sections that follows illustrates the application of the stepwise framework in search of the generative mechanisms that can explain why existing HIS implementation in public healthcare facilities in resource-constrained environments do not adequately facilitate healthcare service delivery. The first step is the case description.

The case and unit of analysis

The term constraint is used in this study to refer to those effects that limit healthcare service delivery in public healthcare institutions. Constraints in this paper was categorized into two types of limits; time and resource limitations. 'Time-constraints' in the context of this study would refers to the overall turnaround time of achieving healthcare service delivery outcomes, whilst 'resource-constraints' refer to more controllable elements, such as staffing, materials and access to needed equipment to carry out healthcare activities. The empirical case used is located in the OR Tambo Municipality in the Eastern Cape Province of South Africa. Historically this region has experienced challenges associated with service delivery and the healthcare sector is no different. Both the municipality and the healthcare facilities in this region bear characteristics such low skills of a resource constrained environment. This can be attributed to urban migration where skilled worker prefer to move to better opportunities. The facility is government funded and provide tertiary healthcare services to entire region. The selection criteria of the facilities was also based on the availability of health information systems such as the District health information system, patient records management system, and laboratory information system.

Sampling of Participant

Data was gathered from participants from the empirical case who were selected using purposive sampling technique to produce a sample that could plausibly be assumed to be representative of the case. To accomplish this, the researcher applied expert knowledge of the population to select in a non-random manner a sample of subjects that represents a cross-section of the population. The study's criteria for selecting the sample consisted of senior hospital and clinic managers (as they oversee the healthcare service delivery process at the hospital); Technical support administrators (as they are offer technical support on implemented technologies); clinical and medical staff including nurses (as they are the users of these systems for clinical work to provide services); administrators and clerks (as they use the systems for administrative activities to support the clinical activities); Provincial ICT directors (representative from the department of health- as they oversee the adoption and implementation of various technology projects in public healthcare facilities within the province). A total of 21 interviews were carried out over the course of 6 weeks.

Ethical considerations

Ethical considerations are principles and regulations guiding the handling of research in specific contexts [37] To conduct any data collection, the researcher adhered to all the ethical procedures stipulated by Cape Peninsula University of Technology and Eastern Cape province of South Africa, the Eastern Cape Health Department. This also included seeking informed consent from the hospital and the participants.

For data analysis, Activity Analysis and Development (ActAD) framework is used as a backdrop to the conceptual exploration and as an analytical lens together with thematic and content analysis (for document analysis) technique. Thematic analysis is used to construct thematic understanding of the empirical data. The ActAD framework in Figure 3 is used as an operation tool to understand, analyse and explain goals, procedures, actions, interactions and relationships between actors, tools and the environment of healthcare service delivery system in public hospitals.

ActAD is based on Activity theory, which assumes that IS projects such HIS implementation are a collection of work activities [38]. Work activity according the (*ibid*) is a view of social activity as widely accepted, rule-based, deliberate and collective work by various subjects. This is in pursuit of a common purpose. Subject in the work activity use tools to carry out action towards achieving an outcome (goal) [39]. According to [40], the work activity can be complex, situation dependent, and subject to value conflict as a result of the various actors with different activities and the pursued purpose that is shared by others (community).

Drawing on the ActAD framework, the healthcare service delivery in this paper is considered a collection of activities that are carried out by different actors (healthcare practitioners) whose common pursued purpose (object) is shared by others (community). As result the healthcare service delivery as a work activity is described as a complex, highly mutable, situation-dependent, and subject to value conflicts [40]. The framework suggests that the notion of the purpose (healthcare service delivery) does not occur without purpose, but is in pursuit of an identifiable outcome (improved healthcare service delivery). Whether the implementation process of HIS in public hospitals is associated to a specific care purpose, has an impact on whether the tool is utilized and how. This is a key point towards understanding the factors of HIS usage in that it could (together with other factors) explain some aspects of usage (or non-usage) to facilitate healthcare service delivery. The framework also indicates that the purpose in the work activity exists before and along the activity, it does have a time-frame that end with the transformation of the object into an outcome, or an alteration of the purpose to achieve a desired outcome, possibly due to contextual factors. A desired outcome is a function of a successful interplay between the object and the action as well as mediation process, where the purpose goes through a satisfactory transformation into an outcome. The activity, therefore never an ends in itself, but a goal-oriented process toward a realization of the outcome (health).

Results

The results of this paper aims to provide an understanding of the context of healthcare service delivery in public healthcare service delivery in healthcare facilities in resource-constrained environment. Firstly, in the result section the paper showcase the context-based mediators that influence healthcare service delivery and also how those mediators together with the mediators that influence HIS implementation and use transform the outcome (desired or undesired) healthcare service delivery. In doing this, the paper attempts to give an explanation of why the current implementation of HIS in the public healthcare sector in South Africa is not adequately facilitating healthcare service delivery. The ActAD model posits that the work activities are mediated by mediators such as tools, rules, context, conditions and artefacts. In the healthcare service delivery as a work activity system, activities are mediated by tool such as HIS, rules such as those provided by the National health Act of 2003 and a context such as resource-constrained environment. The transformation of the shared object into outcome (desired or undesired) of the object have a predetermined timeframe (the historical aspect work activity). That is in a healthcare delivery system, the transformation of outcomes such as improve healthcare service delivery have a predetermined historical timeframe that defines the outcome into the observable or unobservable events such the status of healthcare service delivery. This could be as a result of the object failing to achieve a desired outcome perhaps as a result of contextual inhibitors.

The interaction amongst the work activities, available tools and systems functionality and human behavioural factors have both inhibiting and enabling implications. For example, resistance to change and user competencies (technical knowhow) can have inhibiting effects on the use of HIS to facilitate healthcare service delivery. In another example, the results suggest that barriers to optimal use of these systems into three, limited functionalities, access barriers of patient information due to the limited functionalities and facilities management inertia. As explained herein (Figure 4), HIS implementation plays into the non-linear complexities of the health delivery process influenced by emerging context-based factors.

From figure the two classifications of healthcare processes, healthcare work activities are categorized into either *care* or *co-ordination activities*. The *co-ordination activities* involve patient and external co-ordination. Patient co-ordination involves organizing patient care activities and sharing medical information among all actors involved in the provision of care to a patient with a goal of achieving adequate healthcare service delivery. External co-ordination activities on the other hand encompasses managing the interchange of clinical information from different systems at the hospital for decision making purposes. The care activities involve the provision of care at the hospital performed by healthcare practitioners to assess, change, or maintain the health of a patient. This takes place within the hospital's units or departments (service provision context). Care documentation activities are at the core of care provision, with most healthcare practitioners indicating that it is a necessity in the delivery of care service process.

Context-based factors that influence Healthcare service delivery

The result from the analysis in this paper indicate that there are several mediating factors that with causal powers that may enable or inhibit the public healthcare service delivery. These factors mediate observed outcomes reflecting the current status of healthcare service delivery in the country that does reflect the mandate of the National government of providing equitable access to quality healthcare services to all. The outcomes (including long queues at healthcare facilities, poor quality of data captured, inadequate records management and the rise in healthcare costs) are mediated by several factors such as those presented in Table 1.

Table 1: Context based Mediating factors that influence healthcare service delivery

Enabling factors	Inhibiting factors
✓ Adequate availability ICT infrastructure	✓ Shortage of resources
✓ Adequate health policies and strategies	✓ Lack of accountability and transparency
✓ Increased access to healthcare services	✓ Inadequate skills and knowledge
	✓ Poor leadership and inadequate management
	✓ Low morale and dissatisfaction of healthcare practitioners

These mediators may explain the relationships between the healthcare service delivery as outcomes as dependent variable and the mediators as independent variables. This may explain the current status of public healthcare service delivery as observed and experienced by patients and are categorized into enabling and inhibiting mediators. The inhibiting mediators include poor leadership and inadequate management capabilities; maldistribution of resources across the healthcare system; lack of accountability; inadequate skilled healthcare workforce. Whilst the enabling mediators include improved healthcare facilities, improved ICT infrastructure, adequate health policies and strategies and adequate amongst others. These mediators mediate the outcomes which shapes the observed state of healthcare service delivery at the hospital. The transformation in the work activities as a result of these mechanisms occur at individual level or as a collective in the work activity system. The nature (desired or undesired) of outcomes and the activities are therefore dependent variables, whilst the mediators are independent variables. Figure 5 depicts the relationship of between the independent variables, context based mediators and the dependent variable which the transformation of healthcare service delivery into desired or undesired outcomes.

Drawing on the stratified ontology of critical realist paradigm enables this study to investigate and explain the potential relation. Therefore, the argument this study makes is that a positive interplay between the shared purpose (object) from the mediation process and the actions of the different

stakeholders result into desired outcomes. Where the object undergoes a positive transformation into an outcome. The transformation of the object into outcomes have a predetermined timeframe (historical) in a work activity. This could be as a result of the object failing to achieve a desired outcome as a result of contextual inhibitors.

Based on the ActAD framework, these outcomes are mediated by contextual factors that transform the HIS implementation activities to the outcomes (observable or unobservable). The ActAD framework allowed the study to gain a better understanding of those findings. Outcomes such as limited interoperability between different systems, poor coordination of the system and lack of integration [3, 41] are mediated by contextual factors. Other outcomes include plethora of silo pilots of technological solutions that are often not scalable [42]. Figure illustrates the relations between the independent and the dependent variables and how these contextual mediators shape the implementation of HIS in public healthcare facilities into the outcomes as presented as findings. Based on the stratified ontology, these are the observable (empirical) and unobservable events (actual) from the empirical evidence.

The outcomes showcased in the figure allude to inefficiencies in the current HIS implementation practice, these inefficiencies are mediated by contextual factors that may be able to explain the outcomes observed and experienced. The study identified a factor that mediates the current HIS implementation outcomes is the lack of understanding among the leaders and management in the healthcare system of what healthcare practitioners need; the design or functionality that does not support healthcare institutional workflow or users' work routines. These mediating factors tend to negatively influence activities that transform the outcome of HIS implementation such as the already mentioned outcome such as interoperability and many others. The paper also approaches the implementation of HIS as a set of activities within the broader work activity system mediated by contextual mediators as indicated in Figure 6. This highlights the importance of examining the mediating role of healthcare organization structure by analysing and explaining how its properties represented in Figure 6 as contextual factors that cause transformation that lead to the outcomes (desirable or undesirable).

The purpose of this paper was to present emerging context-based mediators and generative mechanisms for HIS implementation and use in public healthcare hospitals within resource constrained environments in South African context. The study has shown that contextual factors as described previously can generate causal mechanism that may impact the implementation of HISs in public hospitals and the subsequent use to adequately facilitate healthcare service delivery. The findings add to the understanding of the use critical realism methodology to identify the mechanisms and structures that may impede or enable HIS implementation and subsequent adequate usage in resource constrained environments. In general, therefore, the results shows the importance of understanding these mechanisms and others in varied contexts. The study concludes that for policy makers in government and the national department of health, addressing the inhibiting factors or challenges faced in the his implementation process should go beyond just the identification and addressing of context-based factors. Of importance is also their generative mechanisms. Being able to identify and characterise these mechanisms would enable the department of health to put measure in place to mitigate mechanisms that produce inhibiting outcomes

and leverage on the enabling mechanisms this may prove beneficial in sustaining his implementation and use in public hospitals for an improved healthcare service delivery.

Conclusion

The purpose of this paper was to present emerging context-based mediators and generative mechanisms for HIS implementation and use in public healthcare hospitals within resource constrained environments in South African context. The study has shown that contextual factors as described previously can generate causal mechanism that may impact the implementation of HISs in public hospitals and the subsequent use to adequately facilitate healthcare service delivery. The findings add to the understanding of the use critical realism methodology to identify the mechanisms and structures that may impede or enable HIS implementation and subsequent adequate usage in resource constrained environments. In general, therefore, the results shows the importance of understanding these mechanisms and others in varied contexts. The study concludes that for policy makers in government and the national department of health, addressing the inhibiting factors or challenges faced in the his implementation process should go beyond just the identification and addressing of context-based factors. Of importance is also their generative mechanisms. Being able to identify and characterise these mechanisms would enable the department of health to put measure in place to mitigate mechanisms that produce inhibiting outcomes and leverage on the enabling mechanisms this may prove beneficial in sustaining his implementation and use in public hospitals for an improved healthcare service delivery.

Abbreviations

HIS: Healthcare information systems; IS: information systems; ActAD: Activity Analysis and Development

Declarations

Acknowledgement

No other persons contributed to the work that does not meet the authorship criteria.

Author contribution

Mourine and Prof Ruhode defined the scope and the research design. Mourine was responsible for data collection and analysis. Mourine carried out the write-up of the article, with Prof Ruhode reviewing the work.

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Availability of data and materials

The datasets used and analysed in the duration of these study are available from the corresponding author on reasonable request. The data are not publicly available due to privacy and/or ethical restrictions.

Ethics approval and consent to Participate

For the research to be carried out, the researcher adhered to all the ethical procedures stipulated by Cape Peninsula University of Technology this involved seeking clearance from the institution (HEALTH AND WELLNESS SCIENCES RESEARCH ETHICS COMMITTEE (HW-REC) Registration Number NHREC: REC-230408-014). Once approval from this committee the researcher approached the Eastern Cape Health Department for ethical clearance (EC_201712_011). The respondents signed a consent form of their anonymity as well as the confidentiality of the data they provided.

Competing Interests

The authors declare there are no competing interests.

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Figures

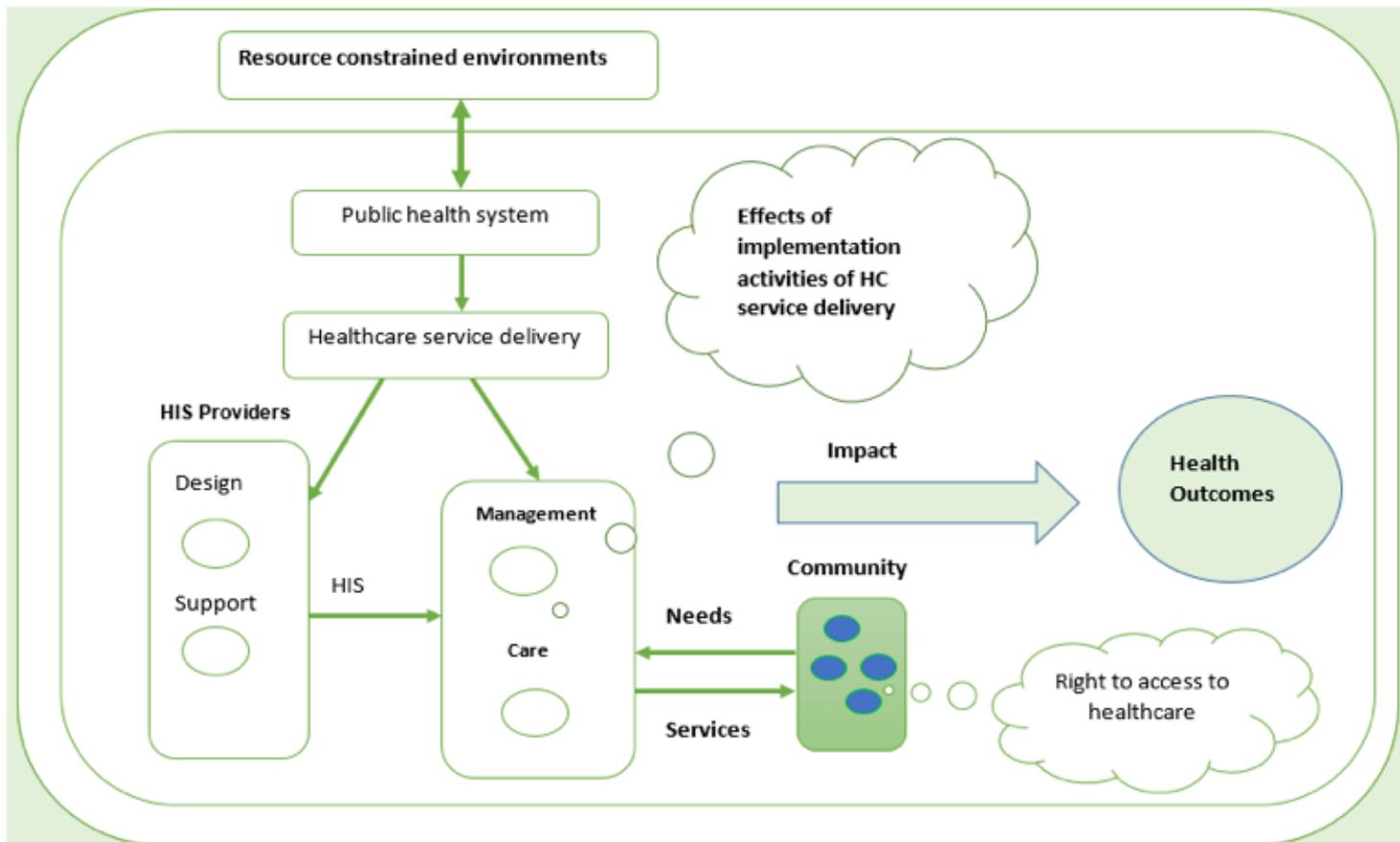


Figure 1

Conceptual Framework: ICTs and the public healthcare sector

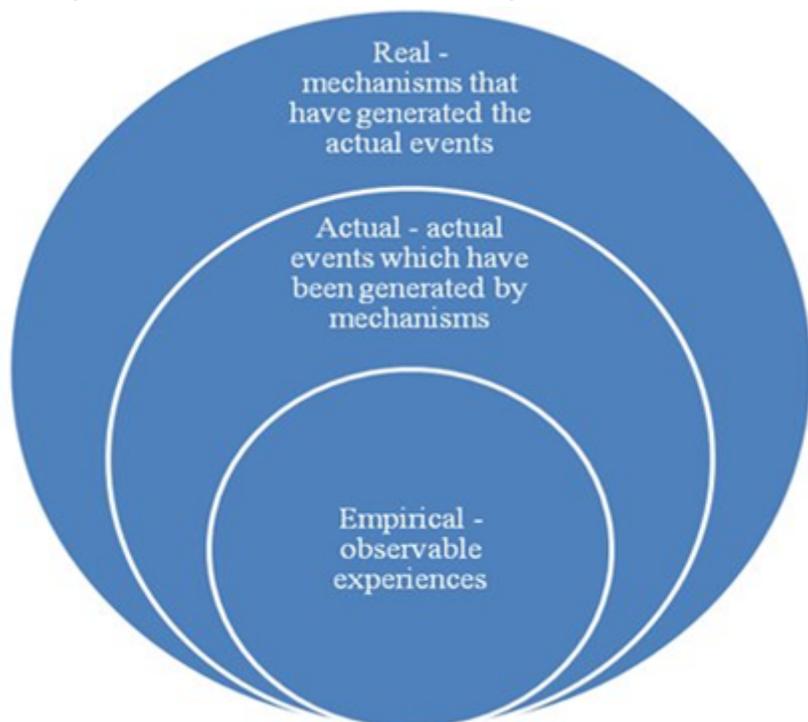


Figure 2

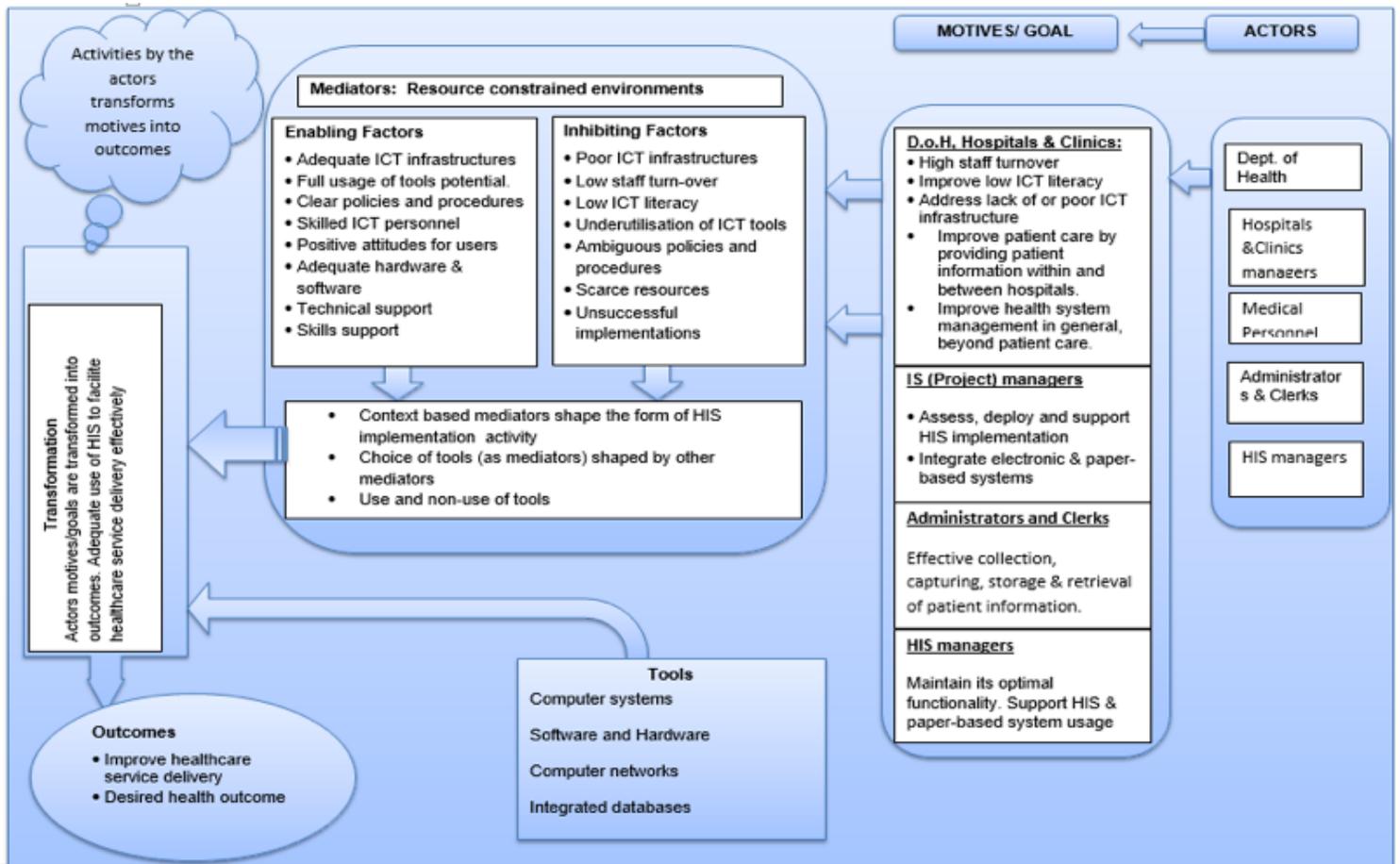


Figure 3

ActAD Analytical framework used as an explanatory tool

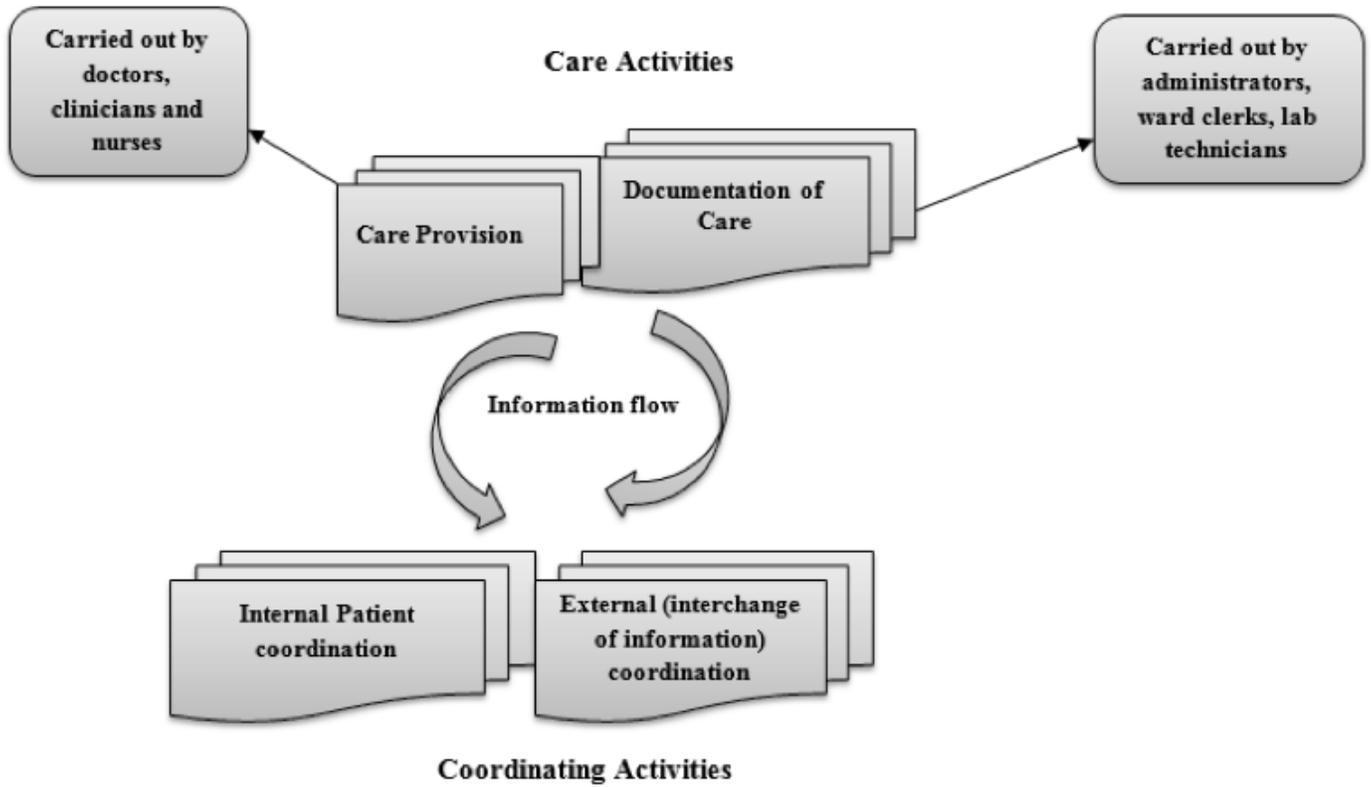


Figure 4

Healthcare Activities within the care service delivery process

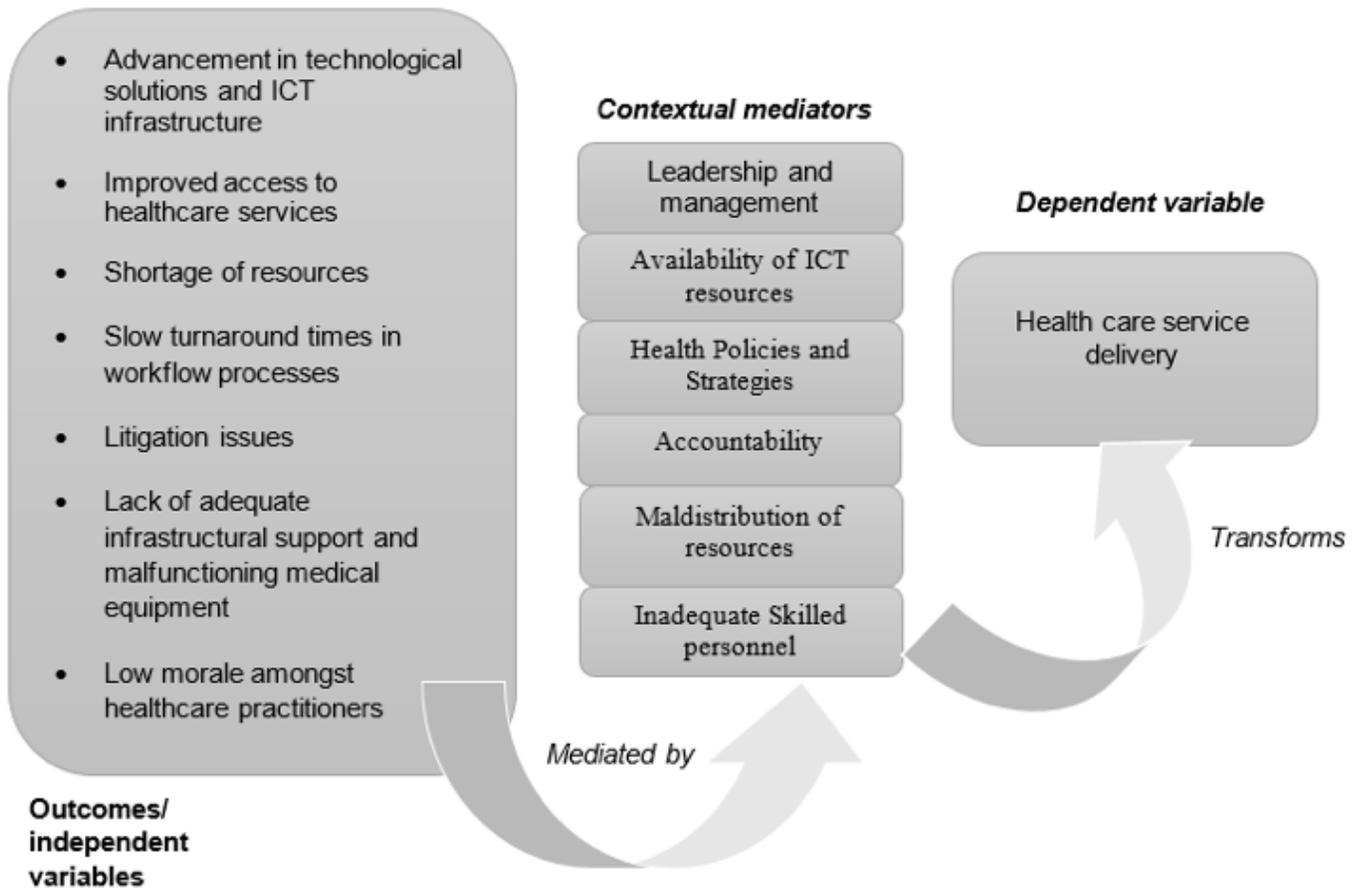


Figure 5

The interactions of the mediators of healthcare service delivery outcomes

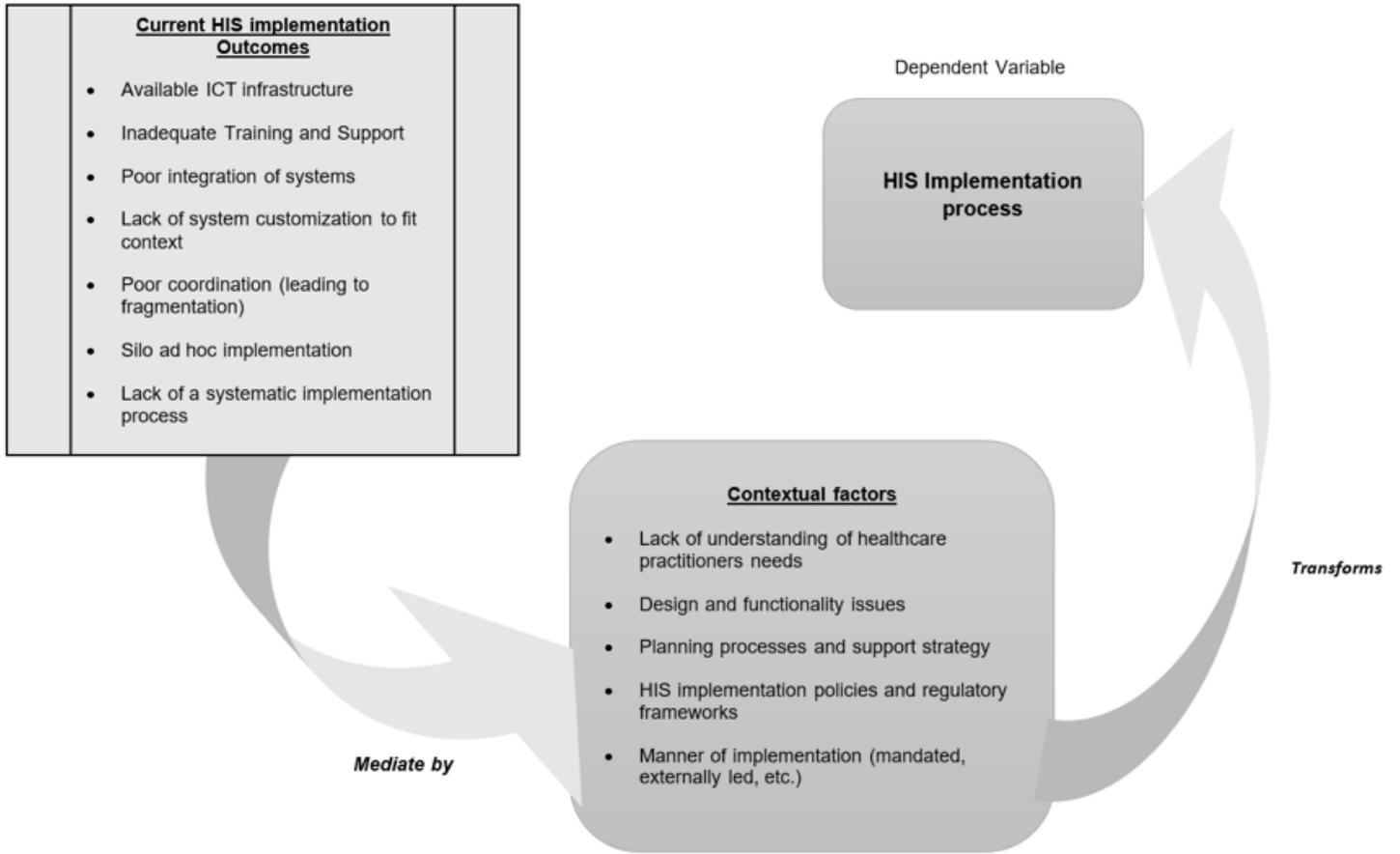


Figure 6

Mediating Factors that shape the form of HIS implementation