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Application of system thinking concepts in health system strengthening in low-income settings: a proposed conceptual framework for the evaluation of a complex health system intervention: the case of the BHOMA intervention in Zambia

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Abstract

Background The current drive to strengthen health systems provides an opportunity to develop new strategies that will enable countries to achieve targets for millennium development goals. In this paper, we present a proposed framework for evaluating a new health system strengthening intervention in Zambia known as Better Health Outcomes through Mentoring and Assessment.

Approach We briefly describe the intervention design and focus on the proposed evaluation approach through the lens of systems thinking.

Discussion In this paper, we present a proposed framework to evaluate a complex health system intervention applying systems thinking concepts. We hope that lessons learnt from this process will help to adapt the intervention and limit unintended negative consequences while promoting positive effects. Emphasis will be paid to interaction and interdependence between health system building blocks, context and the community.

Introduction

One major breakthrough in understanding the complex world of organizations is from systems theory. Systems theory underscores the importance of looking at systems from a broader perspective rather than simple parts, which make up the system [1]. Where reductionists would like to dissect a complex process and study the individual parts separately, systems theory highlights the importance of understanding the complete system and the underlying interactions of all the forces that make up that system [1–3]. Systems theory has greatly influenced the way we understand and change organization performance [4,5]. The theory was introduced by Ludwig von Bertalanffy in the 1940s in when he described systems theory as a general science of wholeness [2].

The application of this theory is called systems analysis. One of the major tools of systems analysis is systems thinking [3]. In simple terms, systems thinking is a way of helping an individual to view systems from a broad perspective that includes seeing overall structures, patterns and cycles in systems, rather than seeing only specific events in the system [3,4].

Systems thinking has been applied in diverse fields such as engineering, economics and ecology. Such work has shown that systems are constantly changing, with components that are tightly connected and highly sensitive to change elsewhere in the system. They tend to have non-linear relationships and usually unpredictable [3,6]. Systems are often resistant to change, with seemingly obvious solutions sometimes worsening a problem [1,5].

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To understand and appreciate the relationships within systems, several recent projects have adopted systems thinking to tackle complex health problems and risk factors. Systems thinking has been applied in tobacco control, obesity and tuberculosis research [5–7]. However, the application of systems thinking at broader level of health systems has remained untapped [8].

According to a recent World Health Organization (WHO) publication [8], systems thinking can open powerful pathways to identifying and resolving health system challenges and as such is a crucial ingredient for any health system strengthening. In evaluation of health system building blocks, which include service delivery, health workforce, information, medical products and technologies, financing, and governance, WHO has been advocating for the adoption of systems-wide approaches such as systems thinking [6,9].

Julio Frenk has argued that part of the problem with the health systems debate is that too often it has adopted a reductionist perspective that ignores other important aspects [10]. It is therefore important that future interventions and evaluations take a more comprehensive view that expands and challenges the status quo [6,11]. In this regard, there is need to apply systems thinking in the design and evaluation of health system strengthening interventions. It is crucial to systematically explore the interconnectedness between different building blocks. Systems thinking opens the opportunity to discover both intended and unintended consequences of any health intervention [8,9]. This dynamic view, entails looking at actors and actions as the building blocks interact with each other but also with the target population in which the intervention is being implemented [6,9,10].

In this paper, we present the proposed framework for evaluating a complex health system intervention in Zambia known as Better Health Outcomes Through Mentoring and Assessment (BHOMA), applying system thinking concepts looking at intended and unintended consequences [6]. The aim is to provide an evaluation plan that is adaptive and responsive to the intervention and context. This process is essential especially that the intervention is being applied in a complex adaptive health care system [6,9].

Designing an intervention on the basis of systems thinking: the BHOMA

Zambia is one of the countries that are lagging behind in achieving millennium development targets. Several barriers have been identified as hindering the progress towards health-related millennium development goals. These include socio-cultural practices, poor referral systems, limited health infrastructure and lack of qualified health human resource. These barriers limit access to health services especially in rural areas. Designing an intervention that addresses these barriers was crucial and with calls for systems strengthening high on the global agenda, the BHOMA project was born with the current challenges in the Zambia's Ministry of Health (MoH) in mind and the need to provide a system-wide solution rather than disease specific.

The BHOMA project is a randomized cluster trial that aims to strengthen the health system in three rural districts of Zambia, namely. Chongwe, Kafue and Luangwa covering 48 health facilities (six pilot sites and 42 intervention sites). The trial has a stepped wedge design where the intervention is being rolled out 'stepwise' at specified time interval until all eligible health facilities receive the intervention. The overall end point of the trial is the reduction in age-adjusted adult mortality rate.

The BHOMA model is made up of three primary strategies, designed to work at different levels of the health system. These are district, health facility and community strategies. The following is a summary description of the three BHOMA strategies:

The district strategy

Each of the three districts has one quality improvement (QI) team that implements the intervention in target health facilities. Each QI team consists of two nurses and one clinical officer. The QI teams have undergone advanced clinical and quality improvement training. The teams work closely with the district clinical care specialist who represents the interest of the MoH. The district QI team is supported by the central QI team that provides technical and logistical support to the district teams. The district team implements the intervention in target health facilities in step wedged fashion. At the health facility, the QI team works intensively with local clinic staff to build clinical skills, applying clinical protocols and algorithms, completing forms and reviewing patients together. They work one-on-one to mentor health workers about good patient consultation, ordering appropriate investigations, interpreting results and working through diagnoses.

The health facility strategy

The health facility-based intervention targets improvement in clinical care quality by implementing practical tools that establish clear clinical care standards. Resources are provided to meet these standards with support from the QI team. As part of self assessment, each clinic generates reports that help to identify areas of weakness for further improvement. Training and mentorship is provided to health workers targeting patient consultation, checking for danger signs and management of common illnesses. Additional training is provided in governance, finance, supply chain and human resource management. The main human resource support consists of community workers trained as 'clinic supporters'. These lay workers are trained to assume as many non-clinical duties as possible. These include registration of patients, filing, triaging, recording vital signs, fast tracking urgent cases and routing patients through services.

The community strategy

The BHOMA project has engaged community health workers on part time basis. They are trained in providing preventive services and tracking missed clinic appointments. They work in collaboration with community health units known as Neighborhood Health Committees (NHCs) and Traditional Birth Attendants (TBAs). The community health workers are also being trained in capturing and recording local health data and sending it to health facilities via mobile phones or physically. Community health workers work with NHCs and TBAs to increase community awareness and participation in health programmes. Figure 1 summarizes the components of the BHOMA intervention.

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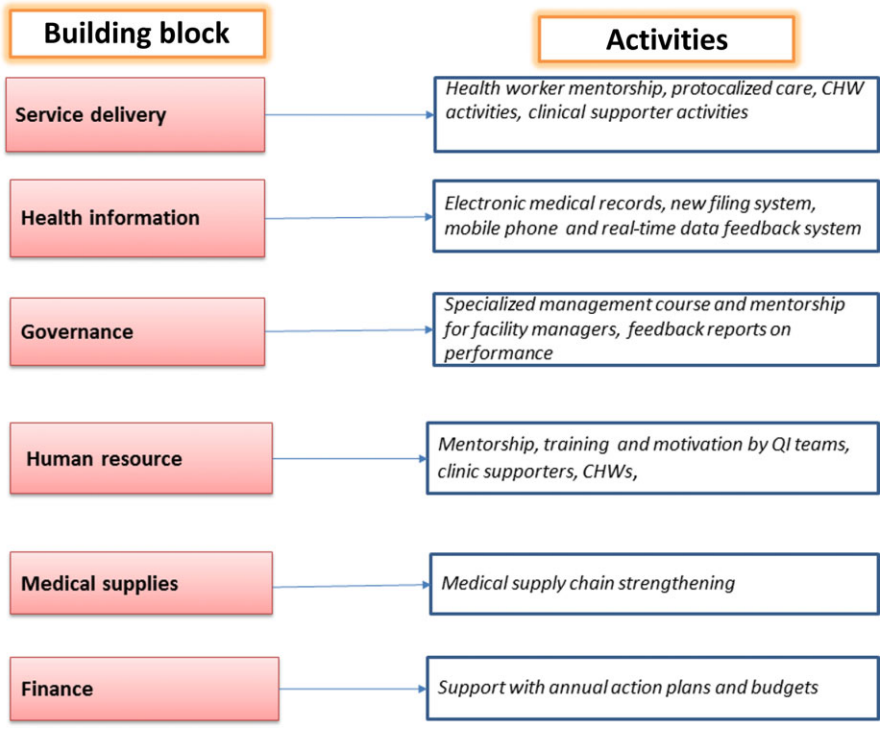

Figure 1 BHOMA intervention building block specific activities.

Implementation and evaluation teams

In order to ensure objective evaluation, the BHOMA study has a separate implementation and evaluation teams. The intervention implementation is being done by the Centre for Infection Disease Research in Zambia (CIDRZ).

The evaluation is being done by the Zambia AIDS Related Tuberculosis (ZAMBART) supported by the London School of Hygiene and Tropical Medicine. There is a close collaboration between the implementation and the evaluation teams to ensure that the evaluation is tailored to the intervention and adapt the intervention according to the results of the ongoing learning process.

Evaluation design for the BHOMA intervention

Rigorous evaluation of any intervention requires careful study design that takes into account possible confounders. The recommended gold standard is a randomized clinical trial (RCT) design as it ensures that intervention and control groups are comparable on as many factors. Though RCTs may have their advantages, they equally have well recognized pitfalls and limitations [12,13]. RCTs were designed to randomize large numbers of people into control or intervention arms, often aimed at addressing narrowly specified questions with the goal of maximizing internal validity [13].This is often different from health system interventions, which are usually delivered to groups, clinics, facilities or as districts and the intervention may have multiple goals and questions. In addition, the heterogeneity in the baseline characteristics of the study units of a health system, implies that sources of error may be inherent to specific health facilities [12]. It has been recognized that health systems are complex and dynamic [6]. It is usually not simple to isolate the cause and effect [6]. The BHOMA intervention being centred around the catchment population attending one health facility is suitable for evaluation through a cluster-randomized approach. However, the intervention is complex and labour intensive and therefore must be rolled out gradually, from one clinic to the next over a period of 5 years. This makes the intervention amenable to evaluation through a variation of the cluster-randomized design, known as 'stepped wedge'. The use of RCT in the BHOMA is simply a starting point and this being a complex intervention implies that causal pathways and assumptions of RCT may not hold true in these real-life settings. Hence, the need to complement RCT with process evaluation and qualitative methodologies that could facilitate a comprehensive evaluation, requiring application of system-wide approaches such as systems thinking [7,12]. This will enable the intervention to be monitored and evaluated for both intended and unintended consequences as well as reporting contextual factors that facilitate adoption or failure of the intervention [6,9].

We shall use a modified health system building blocks framework to guide the evaluation process. Emphasis will be placed on the interaction and interdependence across and within building blocks from a systems thinking perspective. We will also look at how the demand side of health services (community) interacts with the intervention given the context in which the intervention is being implemented. We hope to demonstrate the pathways through which the intervention will act to achieve the outcome of interest (age-adjusted adult mortality rate).The changes will be followed from both demand and supply side perspectives.

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Hypothesis: impact or causal pathways

We believe that the intervention will act both by 'push' and 'pull' mechanisms. By improving clinical care at the health centre we believe that the community will be drawn to better services and that this increased utilization will also be pushed from the community side by better health outreach and information through the community package in the BHOMA intervention.

Main study question

1 What indicators can be used to mark the performance of a strengthened health system?
2 What is the effect of the BHOMA intervention on the health system in the target districts?
3 What are the important processes, contextual and system factors that could explain the observed changes?

The BHOMA intervention is a complex health system intervention, which targets the building blocks for health system strengthening. It is therefore important to anticipate how the intervention might flow through, react with and impinge on these sub-systems. This requires flexibility and learning in the implementation process maximizing the intended while minimizing the unintended consequences. This provides an opportunity to apply systems thinking in evaluating the current BHOMA intervention as it will allow a system-wide evaluation of the intervention [8]. Following is the proposed causal loop diagram of possible interaction across the health system building blocks, context and the community in response to the intervention.

Central to the BHOMA intervention is quality improvement in health service delivery through mentorship of health workers and provision of basic supplies at health facility level. The QI teams and their activities are major drivers of the intervention. The aim in the short term is to improve service quality and coverage leading to improvement in impact indicator, which for the BHOMA intervention is 'age-adjusted adult mortality rate'.

The intervention will therefore affect several health system building blocks either directly or indirectly. The affected building blocks could in turn influence other building blocks positively or negatively. In some cases both positive and negative effects could occur simultaneously.

Figure 2 illustrates the dynamic causal web in the form of a causal loop diagram. It is envisaged that improvement in the quality of services will lead to improvement in coverage through increased community demand for services. This improvement can be facilitated and mediated through single or several interactions between the building blocks. For example, through mentoring, training and supervision of health workers, their competences and motivation could be improved leading to good clinical care and hence community demand for services would improve.

However, the increased demand may have unintended consequences where the demand for the services exceeds the capacity of health workers to deliver the services, hence the services may remain poor despite the presence of the intervention. This will in turn result in reduced demand as shown by the negative feedback loops B1 and B2 (See Fig. 2).

The other elements to be improved will be information collection and use. This will firmly support good decision making, thereby supporting improvements in governance, which in turn will improve human resource management, leading to motivation of health workers and community participation, transparency and improved medical supply. Improvement in supply chain management and availability of essential supplies will in turn lead to increased demand for services in the community. Feedback loop

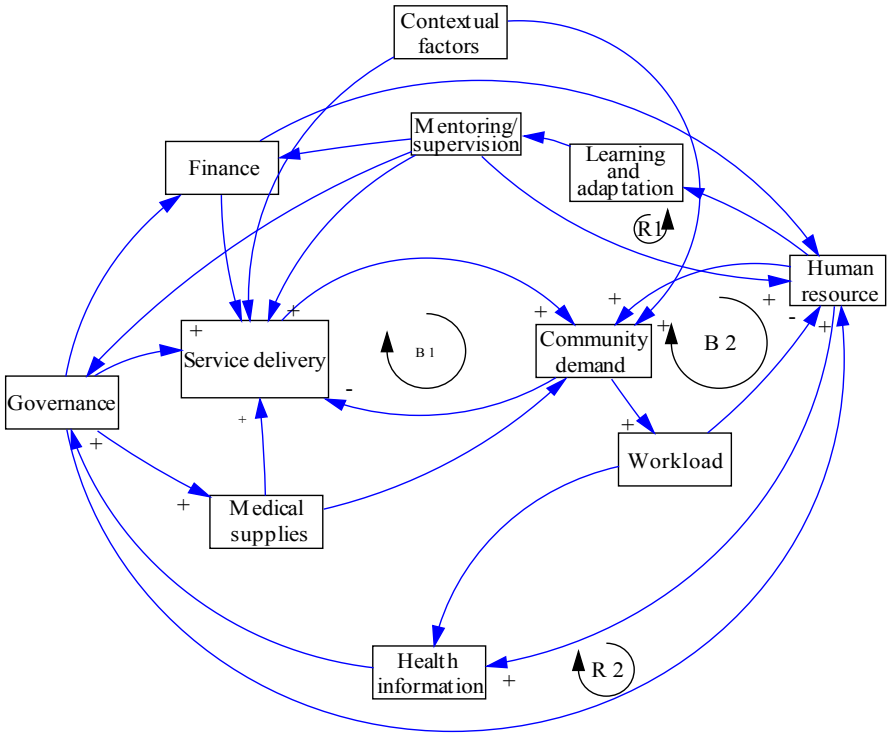

Figure 2 Causal loop diagram: proposed mechanism of interaction between the six WHO building, context and the community.

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(R2) is reinforcing describing the interaction between human resource, health information and governance.

Another positive feedback loop (R1) is noted between mentorship and human resource supported through the process of learning and adaptation of the intervention, leading to improved mentorship and better acceptability of the intervention by health workers. It is important to note that several links are continuous and it is not possible to show cause or effect but rather observe and explain relationships as they occur over time. For example, better governance can lead to improvement in human resource management, but governance in turn depends on availability of trained human resources who are well supported by quality and timely information.

Financial resource management may partly depend on governance but also competent human resources who are responsive to community needs and demands.

One important thing to point out is the influence of context and how it interacts and modifies the intervention [6]. Several issues come under contextual factors some of these which could act as facilitators while others could act as barriers to health service demand. For example, rural communities often have traditional structures, which support new health initiatives through headmen or chiefs. On the other hand, certain negative traditional beliefs and practices can negatively affect intervention success. This complexity warrants the application of systems thinking concepts to allow for the capture of the dynamic interaction between and across building blocks.

Subsystem evaluations from systems thinking perspective

Table 1 shows the health system building blocks and critical evaluation steps, which relate to systems thinking. To illustrate how this table shall be used, we shall look at the human resource building block as an example. The overall question in the human resource building block is has the human resource changed and how has it changed following the intervention?

1 The process: establishing baseline data and then conducting follow-up studies answering the following: are the human resource guidelines being implemented as planned? What practices are there for motivation and incentives?

2 Context: failure to understand the context can lead to wrong interpretation of results. The question of attribution needs special consideration, hence the need to answer the following: What other interventions are targeting human resource in the study districts? Are there national initiatives on human resource that can negatively or positively affect the human resource in health? What is the general economic condition at present and during the study time in Zambia?

3 Effect: measuring the effect is very important to show whether the intervention is working or not. Systems thinking application require looking for effects beyond just the building block in which the intervention was done. Hence, under human resource, we need to answer the following: what is the effect of human resources on service delivery? What is the effect of human resource on other sub-systems including governance, health information and finance? The BHOMA intervention is targeting training and mentoring of health human resources and recruitment of community health supporters. Changes in these aspects will help to know what is happening in the human resource building block and whether the effect can be traced in other building blocks. We will use a balanced scorecard to report the effects across the building blocks.

4 Indicators and data sources: choosing appropriate indicators is very important to demonstrate desired changes, either positive or negative. Evaluation of a complex intervention like the BHOMA requires both quantitative and qualitative methodologies. Selection of indicators was guided by literature, community and health worker consultations in the target districts (see Supporting Information Table S1).

Subsystem positive and negative effects: intended and unintended consequences

Tracking changes of an intervention through the eye of systems thinking requires monitoring both positive and negative effects. In the BHOMA intervention, we have summarized how we envisage the impact of the intervention would be, not only within each building block but also across the continuum of the six building blocks for health system strengthening. The example of human resources will be used again to describe the postulated positive and negative effects of the BHOMA intervention stratified by level of health system administration.

Intervening in the human resources building block will inevitably affect other building blocks. The most obvious spillover effect will be noted in the governance, service delivery, finance and health information where health workers will be mentored on issues of good clinical practice, record keeping and good management practices. This might also lead to better supply chain management. The effect will go across all the levels of health care delivery including the district, health facility and community.

Possible direction of effects of intervening in the human resources is summarized in Table 2. It is conceivable that better recruitment practices will lead to increased number of health workers at district level with few posts remaining vacant. This will result in improved density of health workers and supervision capacity. This might have a positive effect of improving service provision. A negative effect could be that when staffs are well trained and mentored they acquire a better profile and might leave the rural health facilities for better jobs in urban areas. Improving human resource conditions may drain resources from other needy areas and these might show poor performance even when the human resource domain is doing well.

At health facility level, the intervention is expected to improve the number of support staff and provide incentives and motivation for the health workers. Hence, service delivery will improve and coverage of services will be better. The possible negative effect could be unhealthy competition for incentives and training opportunities. A higher volume of service demand than available capacity might occur with health services still remaining poor.

The BHOMA intervention will therefore be monitored both for positive and negative effects. It must be noted that the list is not exhaustive but highlights the point, which underpins systems thinking that some unintended consequences may occur even in well-intended interventions [6,9]. These must be known and their effect minimized in order to maximize the good and intended effect [9].

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Table 1 Approach to evaluating the Health Systems Building Blocks: research questions, processes, context and effect tracking within and across the building blocks

	Governance	Finance	Human resources	Health information	Medical supplies	Service delivery	Evaluation approaches
Main sub-system question	Has governance changed? How has governance changed?	Has financing changed? How has it been changed?	Has human resource changed How has this changed?	Has health information changed? How has it changed?	Has medical supply changed? How has it changed?	Has service delivery changed? How has it changed?	Baseline scores Compare intervention and control health facilities
Processes	Are the guidelines on governance being implemented as planned How is this being done?	Are the guidelines on finance being implemented as planned? How is this being done?	Are the human resource guidelines being implemented as planned? What practices are there for motivation and incentives?	Are the guidelines and protocols on health information being implemented as planned?	Are the guidelines on medical supply being implemented as planned? How are they connected to the National system?	Has the implementation of all the sub-systems gone according to plans? What implementation processes affected services delivery and How?	Observation, checklists, qualitative interviews with managers, health workers and service users
Contexts	What other interventions are targeting governance in the area and national level? What are some local cultural and geographical issues affecting governance	What other interventions are targeting Financing? What is the coverage? What are some local cultural and geographical issues affecting financing	What other interventions are targeting human resources in the area and nation? What is the general economic condition? What are some local cultural and geographical issues affecting human resources	What other intervention are targeting HI in the district and national level? Any specific donor driven initiatives related to HI? What are some local culture and geographical issues can affecting Health information	What other intervention aimed at MS is in place? What components of MS are affected? What are some local cultural and geographical issues can affecting medical supply	Are there any interventions in the community or at national level that may influence service delivery? Are there other specific interventions that may affect service delivery?	Key informant interviews at district and health facility level, stakeholder analysis, observations
Effect: dynamic interaction and Interdependence	What is the effect of governance on service delivery, human resources, medical supplies and health information and what are the effects of these subsystems on governance?	What is the effect of finance on human resource, service delivery medical supplies ,Health information ,governance and what are the effects of these subsystems on finance	What is the effect of human resource on service delivery, medical supply, health information, governance, finance and what are the effects of these subsystems on human resource?	What is the effect of health information on service delivery, governance, finance, medical supplies and what are the effects of these subsystems on health information	What is the effect of medical supply on service delivery, health information, human resource , finance, governance and what are the effects of these subsystems on medical supply	What is the effect of service delivery on health information, human resource, finance, governance, medical supply and what are the effects of these subsystems on service delivery?	Conduct both quantitative and qualitative interviews looking for interaction across and within the building blocks

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Table 2 Application of system thinking approach: intended and unintended consequences

Main sub-system	Positive (intended)	Comments	Negative (unintended)	Comments
Service delivery:	- Personalized care - Improved service quality - Motivated staff **Increased utilization, coverage of services**		- Overwhelming demand for services - Overcrowding - Competition for incentives - Falsification of data to get benefit **Poor service quality**	
Human resources	- Improved staffing levels - Improved moral and motivation among health workers **- Improved quality of service-client satisfaction with service** **- Increased utilization** **- Increased coverage**		- Competition to get incentives - Low moral if incentives are low or removed - Overwhelming demand for services **Poor quality of services**	
Medical supplies	- Availability of drugs and supplies at health facility - Fewer stock outs - Good stock management practice - More community confidence **- Increased utilization and coverage**		- Misuse of supplies, e.g. drugs - Stealing of supplies - Sale to black markets - Expiry supplies - Stock out persist - Drug resistance - Corruption **Poor quality of service**	
Health information	- More health information infrastructure at health facilities - Patient level data capture - Less use of stationery - Better record keeping - Community level data included - Good quality and reliable data - Easy to generate local reports **- Timely reporting** **- Evidence-based planning** **- Responsive services**		- Too much work for health workers to enter data - Need data clerk all the time - Other services may be neglected - May suffer from interruption of power and internet services - May become corrupted - Mainly quantitative data - Data may be falsified to reach targets - **Poor quality data** **- Insufficient qualitative data**	
Governance	- Better trained health managers - Better district planning - Evidenced-based planning - Motivate district and health facility workforce - Co-ordinated health services - Better stakeholder involvement - Better retention of human resources		- Loss of trained managers to urban districts. - High turnover of staff **- Poorly trained new managers** **- Bad governance practices persist**	
Finance	- Availability of resources - Efficient use of resources - More accountability - Reduced corruption - Better priority setting - Cost-effective intervention promoted		- More workload to account - Corruption - Other service areas may suffer - Increased misuse of available resources **Corrupt practices persist**	

Bold indicates most important consequences.

Study design

The BHOMA intervention is designed as a stepped wedge randomized cluster trial. The unit of randomization is the health facility and its catchment population. Each health facility has been randomly allocated to receive the intervention in different steps until all the 42 eligible health facilities receive the intervention. The intervention starts in 2011 and end in 2014.

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The full description of the study design is presented in another paper [14].

Data collection and analysis plan

District level data collection

Data will be collected from the district health team. Respondents will include the district director of health, clinical care specialist, pharmacist and health information officer. Interviews will also be held with the quality improvement team to establish challenges in the implementation of the BHOMA intervention.

Health facility surveys

Health facility surveys will be conducted annually in all facilities. Tools for data collection have been adapted from the WHO health facility survey tools, Measure Evaluation and Health Facility Assessment Network. Both quantitative and qualitative data will be collected during the annual surveys. Data capture will follow WHO health building blocks on health system strengthening including governance, finance, human resources, health information, medical supply and service delivery. Contextual factors will also be captured during the annual facility surveys. Attention will be paid to the interaction and dependence between the building blocks, context and the community. Both intended and unintended consequences will be recorded and reported.

Sampling and eligibility criteria

All the 42 target health facilities in the three districts will be included in the annual surveys. Hospitals and private clinics will not be included in the sampling.

Target population

At each health facility, managers and persons in charge of health information, drugs and medical supply and financing will be interviewed. At least two non-managerial health workers will be interviewed separately to get an independent view of services being provided by the health facility. Clinical observations and exit interviews will also be conducted at each health facility. Five (5) observations and five (5) exit interview will be conducted for children and adult services separately. In addition, we will conduct a series of in-depth qualitative interviews (with facility managers and district health managers and focus group discussions (with the community) to enable us to interpret the quantitative results and explore important factors facilitating or hindering the delivery of the intervention. We will have ongoing discussion and consultation with stakeholders to share the results for learning and intervention adaptation.

Household surveys

The full methodology of the household surveys and sample size calculations are presented elsewhere [14]. In summary, household surveys will be conducted in a random sample of 120 households, which fall under respective target health facilities. A household will be eligible for inclusion in the study if it has any person above 18 years of age. The households will be enumerated and a standardized questionnaire based around validated demographic and health indicators from the Demographic and Health Survey will be used. In addition, questions will be asked about health seeking behaviour, coverage of key interventions (based on co-coverage indicators for maternal and child health) and health care expenditure. Additional questions will be asked about recent health care encounters (clinic and community), satisfaction with health care and accessibility of health services.

Reporting the effect: balanced scorecard

Balanced scorecards have been used in health care monitoring and evaluation at patient, facility, district and national level but mostly in high-income countries [15]. Recently, WHO endorsed the balanced scorecard approach in evaluating health system strengthening interventions in low-income countries [16]. One study conducted in Afghanistan used the balanced scorecard system to evaluate the performance of the health system based on selected indicators over a period of 5 years. In this work, Edward *et al*. (2011) made important modifications to the traditional balanced scorecard. They included domains such as patient and community, human resources, service provision and health system preparedness indicators for equipment, essential commodities and infrastructure [17,18]. We will adopt and adapt a similar balanced scorecard approach to capture the systems-wide effects across the health system building blocks. This will be complemented by qualitative data and context analysis.

Analysis plan cycle

Steps

1 Consensus building on the possible effect of the intervention both positive and negative.
2 Developing of questions and data collection tools based on literature and consultation with local stakeholders and pre-testing the tools. Ending with a proposed conceptual framework (causal loop diagram).
3 Baseline balanced scorecard evaluation to compare baseline characteristics focusing on system-wide characteristics and contextual factors (quantitative and qualitative data).
4 Initial learning and validation of baseline results with stakeholders in the target districts.
5 Monitor changes in response to intervention using balanced scorecard and qualitative interviews after 12 months.
6 Analyse the links between the observed effect (intended or unintended), contextual factors and possible counter intuitive results (see Table 2 for positive and negative effects).
7 Learning and intervention adaptation: discussion with stakeholders and intervention implementers to discuss 12 months follow-up findings and possible contextual factors and exploration of the original casual loops diagrams and making adjustments based on lessons learnt.
8 Sharing the new validated causal loop diagram with stakeholders and implementers for future direction and adaptation of the intervention.

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9 24 months follow-up study and repeating the cycle described until the end of the study in 2014.

The basic unit of analysis will be a health facility and its catchment area. Scores will be generated for the health system building blocks using the balanced scorecard approach [19,20]. Quantitative data will be exported to SPSS Version 17 (SPSS Inc., Chicago, IL, USA) for analysis. Comparison will be made at baseline and 12 months post-intervention in control and intervention health facilities. Qualitative data will be analysed using NVIVO software version 10 (QSR International Inc., Burlington, MA, USA).

Discussion

The current drive to strengthen health systems provides an opportunity to develop new strategies that will enable countries to achieve targets for millennium development goals [21,22]. The status quo of public health interventions have been criticized as too narrow and implemented in piece meal fashion, lacking comprehensiveness and whole-system perspective. This compartmentalized approach is said to be engrained in the financial structures, intervention designs and evaluation methods of most health agencies [6]. In recent time, it has been acknowledged that conventional analytical methods are generally unable to satisfactorily address situations in which population needs change over time often in response to the interventions themselves [6,23,24]. The term dynamic complexity has been used to describe such evolving situations [6]. Dynamically complex problems are characterized by long delays between causes and effects and by multiple goals and interests that may in some ways conflict with one another [6]. This makes it difficult to know how, where and when to intervene because most interventions will have unintended consequences and will tend to be resisted or undermined by opposing interests or as a result of limited resources or capacities [6,23,25].

The commonly used frameworks for programme evaluation in health care are logic models. These provide theoretical basis for most evaluation [26]. The logic model proposed by the Kellogg Foundation is one such commonly used model [27]. The assumption underlying all logic models is that there is a logical and unidirectional linear relationship from inputs through to outcome or impact [26,27].

However, it has been recognized that relationships between elements in health care programmes are more complex with feedback loops connecting various elements of a programme. These tend to be non-linear and often unpredictable [9,28]. Logic models that fail to capture these complexities have limitations when it comes to evaluation of complex interventions [26]. This stands in contrast to systems thinking approaches, which take into account the patterns and relationships in a system reflecting both positive and negative feedback loops [26,28].

In our study, we hope to apply systems thinking to address gaps in knowledge on health system strengthening in low-income settings and explore contextual factors that are important in improving health system performance. The use of a systems thinking approach will ensure that we explore relationships and interconnections between health system building blocks looking at both positive and negative effects. It is hoped that this study will facilitate adoption of similar interventions to strengthen the health system in Zambia, justifying the need for using systems-wide approaches.

The study has inherent weaknesses and limitations that must be considered when evaluating the impact in the short or long term. The lifetime of the project is 5 years and yet systems thinking acknowledge that usually there are considerable delays between the intervention and the effects in most systems [1,4]. The 5-year period may be too short to assess the full impact of the intervention. It is therefore recommended to model the results at the end of 5 years and to extrapolate the effect over a longer time frame. We hope that this will be done with the BHOMA intervention. There are several unprecedented activities and funding to accelerate reaching Millenium Development Goals in Zambia, and recently, there has been a change of government. These changing contextual factors may confound the effect of the BHOMA initiative, making it difficult to attribute the effect to the BHOMA intervention. Nonetheless, we hope to keep track of major changes that may affect the results of the BHOMA intervention and take them into consideration when interpreting the results.

Another limitation is related to the inherent weakness and bias in interview data and clinical observations where the responders may give desired answers rather than what is actually happening on the ground. In addition, observations of participants may change the way they practise under normal circumstances. One unique challenge with this study is that it may be viewed as inspection of the performance of managers and their teams at the health facility and they may feel uncomfortable to discuss weaknesses as this may be taken as failure on their part. On the other hand, junior staff may feel intimidated to discuss weaknesses in their work environment for fear of victimization. Since the study will be conducted in rural districts, the results may not be generalized to other settings, making it necessary to conduct similar studies in urban settings. One fact to be acknowledged is that the current study tries to evaluate a complex health system intervention. The methodological challenges are well recognized and this study is no exception [29]. It is hoped that the use of mixed methodology and application of system-wide approaches will help mitigate some of the methodological challenges and limitations.

Conclusion

In this study, we propose to apply system thinking concepts to evaluate a complex health system intervention. We hope that lessons learnt from this process will help to adapt the intervention and limit the unintended consequences while promoting positive effects. Emphasis will be paid to the interaction and interdependence between the health system building blocks, context and the community.

Conflict of interest

The authors declare no conflict of interest.

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