



## A causal loop analysis of the sustainability of integrated community case management in Rwanda



Eric Sarriot <sup>a, c, \*</sup>, Melanie Morrow <sup>a, b, c</sup>, Anne Langston <sup>e</sup>, Jennifer Weiss <sup>d</sup>,  
Justine Landegger <sup>e</sup>, Laban Tsuma <sup>f</sup>

<sup>a</sup> ICF International, Center for Design and Research in Sustainable Health and Human Development (CEDARS), Rockville, MD, USA

<sup>b</sup> World Relief, International Programs, Baltimore, MD, USA

<sup>c</sup> Maternal and Child Survival Program (MCSP), Washington, DC, USA

<sup>d</sup> Concern Worldwide Inc., Operations Department, New York, NY, USA

<sup>e</sup> International Rescue Committee, Health Unit, International Programs Department, New York, NY, USA

<sup>f</sup> Maternal Child Health Integrated Program (MCHIP), Washington, DC, USA

### ARTICLE INFO

#### Article history:

Available online 7 March 2015

#### Keywords:

Sustainability  
Causal loop analysis  
Community case management  
Evaluation  
Health systems  
Rwanda  
Systems thinking  
Community health

### ABSTRACT

Expansion of community health services in Rwanda has come with the national scale up of integrated Community Case Management (iCCM) of malaria, pneumonia and diarrhea. We used a sustainability assessment framework as part of a large-scale project evaluation to identify factors affecting iCCM sustainability (2011). We then (2012) used causal-loop analysis to identify systems determinants of iCCM sustainability from a national systems perspective. This allows us to develop three high-probability future scenarios putting the achievements of community health at risk, and to recommend mitigating strategies. Our causal loop diagram highlights both balancing and reinforcing loops of cause and effect in the national iCCM system. Financial, political and technical scenarios carry high probability for threatening the sustainability through: (1) reduction in performance-based financing resources, (2) political shocks and erosion of political commitment for community health, and (3) insufficient progress in resolving district health systems—“building blocks”—performance gaps. In a complex health system, the consequences of choices may be delayed and hard to predict precisely. Causal loop analysis and scenario mapping make explicit complex cause-and-effects relationships and high probability risks, which need to be anticipated and mitigated.

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### 1. Introduction

Rwanda is currently considered an African “success story” in terms of community-based primary health care, including through the integrated community case management (iCCM) of three major childhood illnesses, malaria, pneumonia and diarrhea (Barat and Schubert, 2007) (Mugeni et al., 2014). Rwanda has achieved impressive reductions in child mortality: under-five deaths have fallen from 196 per 1000 live births in 2000, to 103/1000 in 2008, and 76/1000 in 2010, putting the country on track to achieve

Millennium Development Goal 4 by 2015 (National Institute of Statistics of Rwanda & Ministry of Health, 2012). Different publications provide insights into the potential for sustainability of the iCCM and community health edifice (Marsh et al., 2012; Mugeni et al., 2014; National Institute of Statistics of Rwanda & Ministry of Health, 2012; Sarriot and Kabeho Mwana Final Evaluation Team, 2011), but have not been brought together in a cohesive systems view.

In August 2011, the evaluation of a large scale iCCM project aligned with the national community health policy provided the opportunity to systematically consider the sustainability of specific achievements in malaria, pneumonia and diarrhea control and management at district level. Three international NGOs, Concern Worldwide Inc., the International Rescue Committee and World Relief, were involved in implementation of the Kabeho Mwana

\* Corresponding author. ICF International, Center for Design and Research in Sustainable Health and Human Development (CEDARS), 530 Gaither Road, Suite 500, Rockville, MD 20850, USA.

E-mail address: [Eric.Sarriot@icf.com](mailto:Eric.Sarriot@icf.com) (E. Sarriot).

("Life for a Child") Child Survival Project (2006–2011) in six health districts, representing one-fifth of Rwandan districts and about 18% of the country's total population (1.9 million people). Kabehe Mwana districts outperformed non-participating districts on service utilization indicators (Langston et al., 2014; Sarriot & Kabehe Mwana Final Evaluation Team, 2011), but the national iCCM strategy showed very positive results nonetheless (Mugeni et al., 2014) (For example, care seeking for acute respiratory infections in children 0–23 months progressing nationally from 27% to 50%, and from 13% to 63% in Kabehe Mwana participating districts (National Institute of Statistics of Rwanda & Ministry of Health, 2012; Sarriot & Kabehe Mwana Final Evaluation Team, 2011)).

This paper moves beyond a project evaluation perspective to examine the sustainability of iCCM in Rwanda from a national systems perspective. We chose to use 'systems thinking' methods to provide a picture of the challenges at hand, from the perspective of national levers of decision making.

## 2. Systems approaches and the sustainability framework

There is a growing interest in systems approaches to global health and development as well as in evaluation studies, and the management science literature (Adam, 2014a, 2014b; Adam and de Savigny, 2012; de Savigny and Adam, 2009; Geyer and Rihani, 2010; Hargreaves and Podems, 2012; Jackson, 2006; Paina and Peters, 2011; Peters, Paina & Bennett, 2012a; Peters, 2014; Ramalingam et al., 2008; Rihani, 2002a, 2002b; Williams and Imam, 2007). Systems approaches consider behaviors resulting from interactions between interrelated sub-systems or individual systems' agents.

The interest in systems approaches overlaps strongly with evaluation-research on the question of sustainability (Chambers et al., 2013; Gruen, 2008). A number of tools are available to study sustainability of development work (Shediak-Rizkallah and Bone, 1998). The Sustainability Framework approach was developed in the field of child survival (Sarriot et al., 2004) and its application has been documented over the last 10 years in different international settings (Sarriot et al., 2014; Yourkavitch et al., 2004), and has been applied in HIV (Walsh et al., 2012a) and disability (Blanchet and Girois, 2012).

The Sustainability Framework examines the maintenance of positive health outcomes, or their continued improvement, through social and institutional arrangements between stakeholders, and then moves into the systematic examination of six main components, or set of determinants. These can be modified in context (Walsh et al., 2012b), but generally include: (1) health outcomes themselves, identified as a desirable public good by stakeholders, (2) the quality of the relevant health services, including appropriateness and accessibility, (3) capacity expressed within government (i.e. health districts), (4) capacity of relevant civil society partners (i.e. NGOs), (5) capacity of the communities themselves, and finally (6) the social ecological conditions (including policy and governance) in which districts operate. The Sustainability Framework posits that there are nonlinear interplays between these components, and that many specific elements in its components will be necessary but rarely sufficient alone to guarantee sustainability (Sarriot and Kouletio, 2014).

This paper strengthens the prospective analysis allowed by the Sustainability Framework through the use of causal-loop analysis and scenarios.

## 3. Method

This study is analytical and was informed by the following data sources:

- The evaluation of Kabehe Mwana (August 2011) used population-level knowledge, practice and coverage survey data (May–June 2011);
- It also included collection and analysis of a large number of individual and group interviews, from health systems cadres and professionals on to CHWs and community members;
- The USAID-funded flagship Maternal and Child Health Integrated Program carried out a review of the scale up of iCCM comparing Kabehe Mwana with a non-participating district (Tsuma, 2011);
- The period of the final evaluation of the project created an opportunity for multiple exchanges with MOH stakeholders (notably Community Health Desk, Malaria Control Program, and districts), who provided service statistics used as part of the evaluation;
- Available Rwanda Demographic and Health Survey (RDHS) data reanalyzed to compare Kabehe Mwana and non-participating districts (Langston et al., 2014)) provided important context and national trend data.

The analytical exercise was based on secondary data and did not require ethical review (both RDHS and the small population survey carried out by Kabehe Mwana followed appropriate ethical reviews). It followed three major steps:

- [1] We first used the Sustainability Framework to organize positive and negative factors for the sustainability of health improvements achieved through iCCM organized by the following domains of analysis: Health Outcomes, Health Services, District Health System Capacity, Viability of District Support to iCCM, Capacity of Civil Society, Community Capacity, and finally Political Will and Governance from the national level.

The specific factors identified within these components were based on the Kabehe Mwana project evaluation findings, using participating districts as a purposive sample of one fifth of all national health districts. These findings were organized in a simple table where possible effects were listed and organized according to their potential for positively or negatively affecting sustainability (see [Web Annex/Table 1](#)).

- [2] Our second step used causal loop analysis. Causal loop analysis uses diagrams as systems thinking tools (Rwashana et al., 2014), qualitatively representing dynamical changes in systems, which can be physical or social. Causal loop diagrams map relationships between multiple variables and sub-systems and take into account feedback loops of different types (Peters, Paina & Bennett, 2012b; Richardson, 1986; Rwashana et al., 2014; Williams Bob and Hummelbrunner, 2011b). We used the Vensim PLE software (Ventana Systems Inc. (2009) Vensim, version 5.9) to complete our causal loop analysis and present a system view of the interplay between the different factors identified. [Text Box 1](#) summarizes the nature of relationships mapped in causal loop diagrams.

Starting with the tabular review of factors of Step 1, we identified and mapped in Vensim PLE the variables most relevant to our level of analysis, based on consensus. Considering that "the quest of any model is to ease thinking while still retaining some ability to illuminate reality" (Miller and Page, 2007) we progressively simplified the diagram when details of cause and effect relationships could be kept implicit and reduced without undermining the understanding of the dynamics of the 'iCCM system'. For example,

**Box 1**

Types of effects mapped in the causal loop analysis.

In causal loop diagrams, a **positive (+) arrow** from one variable to the next means that a change in the first causes a change in the second in the same direction, while a **negative (–) arrow** means that a change in the first variable causes a change in the second in the opposite direction.

An example of a **direct effect** is the inability of CHWs to deliver services (“technical quality of CCM delivered”) in the absence of community drugs (in “health system performance gaps”)—for example the national unavailability of zinc (due to a process of repackaging) at the time of the final evaluation.

An **indirect effect** could entail the progressive decrease in “community support for CCM”, following a decrease in the “perceived quality of care delivered by CHWs” after a period of insufficient support and supervision of the CHWs by community health supervisors. In this area, the final evaluation found mixed results, with supervision happening on a regular basis both through community health supervisors and through cell coordinators (also referred to as peer supervision), but less than expected, and with supervisors reporting low expectations that they could increase the level of supervision.

As an example of a **negative (or balancing) feedback loop**, increased demand and support for iCCM will increase utilization of CHW services, which, along with other health promotion interventions, can ultimately reduce the prevalence of child illness, which then decreases the demand for services.

At the same time, reduced demand and utilization of CHWs, can reduce the requirements on health district management and CCM supervision, putting at risk the quality of iCCM, and further reducing demand and utilization. This describes a **positive or self-reinforcing loop**, even if the outcome would not be qualified as “positive” by health system observers.

since we sought to identify sustainability factors affecting the whole national iCCM system, we ended up keeping only one variable for the performance of the district health systems related to different “building blocks.” Weaknesses in building block performance of the health system at district level will increase the burden on the national system to find solutions and affect the performance of the iCCM system, whether these weaknesses relate to supervision, health information, commodities, governance, or human resources. Obviously, a district level analysis would require being specific and considering the ‘devil in the detail’, but we rapidly satisfied ourselves that a single “district health system performance [gaps]” variable was enough to inform our analysis.

We adopted largely neutral variable names, such as *prevalence of fever, pneumonia and diarrhea*, rather than *decreasing prevalence*. This allowed the construction of a logical flow of direct and indirect, positive and negative relationships between variables. (Causal Loop Diagrams being a visual tool, the reader may want to follow the terms italicized in Fig. 1.) For example, *political will* has a direct and positive effect on *community health governance*. *Health system performance gap* has an indirect negative effect on *perceived quality of iCCM*, mediated through the *technical quality of iCCM delivered*. Ultimately this allowed building a visual representation of

relational loops that are either balancing or self-reinforcing.

[3] In the last step of analysis, we identified high probability future scenarios of change in the near to medium-term (Williams Bob and Hummelbrunner, 2011a), with high risks for negative effects on the iCCM system in Rwanda. This process relied on dialogue, “what if” statements, with back and forth to the information mapped in the previous step, informal discussions one-on-one and in small group, co-authors’ reviews of first drafts, discussions with experts on Rwanda and its health system, all leading to iterative revisions. The causal loop exercise provided a background on which to examine the “what if” statements. The diagram thus informed the scenario discussion, but was also enriched or simplified through the development of the scenarios. For example the burdens placed on the national system by gaps in supervision, logistics, or information systems (scenario 3) all seemed to feed into the same process in terms of risks for sustainability. This confirmed the value of “lumping” these variables together in the diagram.

#### 4. Results

The [Web Annex Table](#) presents details of the first step in our analysis—a detailed list of factors for the sustainability of the overall health achievements, with some explanation about expected effects. [Fig. 1](#) presents the resulting causal loop diagram.

The best way to read [Fig. 1](#) is to start with a variable of interest and follow its relationship to other variables. *Utilization of iCCM/CHW services*—our ultimate variable of interest—comes directly from the *demand for iCCM services* and *community support* for these services. Both of these are influenced by the *perceived quality of iCCM*. The demand for iCCM is also however part of a ‘balancing loop’ [B2] whereby, over time and with delays, the impact of quality services and preventive measures (i.e. immunization and potentially environmental) decrease the *prevalence of disease* and consequently will reduce the *demand for iCCM*. We also see that the *technical quality of iCCM* needs to be maintained for prevalence of the diseases to decrease. Although delays are at play (symbolized by “/” marks) *technical quality* needs to be maintained to generate *demand* (indirectly via the effect of *perceived quality*).

All of this ultimately links to *district health system management and supervision of iCCM*. Our graph makes one exception to the rule of keeping variable names neutral, by identifying *health system performance gaps* as a variable. We did this to emphasize its importance and the default situation whereby, in spite of tremendous achievements, few things are certain and fully institutionalized in terms of the basic ‘building block’ functions of the peripheral health system:

The evaluation of Kabeho Mwana stated that “while the community drug supply system could not be considered robust [...] it appeared to be good enough to allow remedial measures, and the continuity of iCCM services. The same can be said of CHW supervision, where stated standards were never met (although one district with two district supervisors instead of one came close).” The evaluation report did state that “supervision happened”, and seemed to have been good enough to support CHW motivation and the resolution of major performance problems, including through peer processes, but the sub-optimal state of these building blocks, however, places a burden on the continuation of iCCM, and the central MOH level has stepped up approaches to evaluation and re-training of CHWs in charge of iCCM (Marsh et al., 2012). Some of these steps are discussed in the recent MOH publication on iCCM scale up (Mugeni et al., 2014).

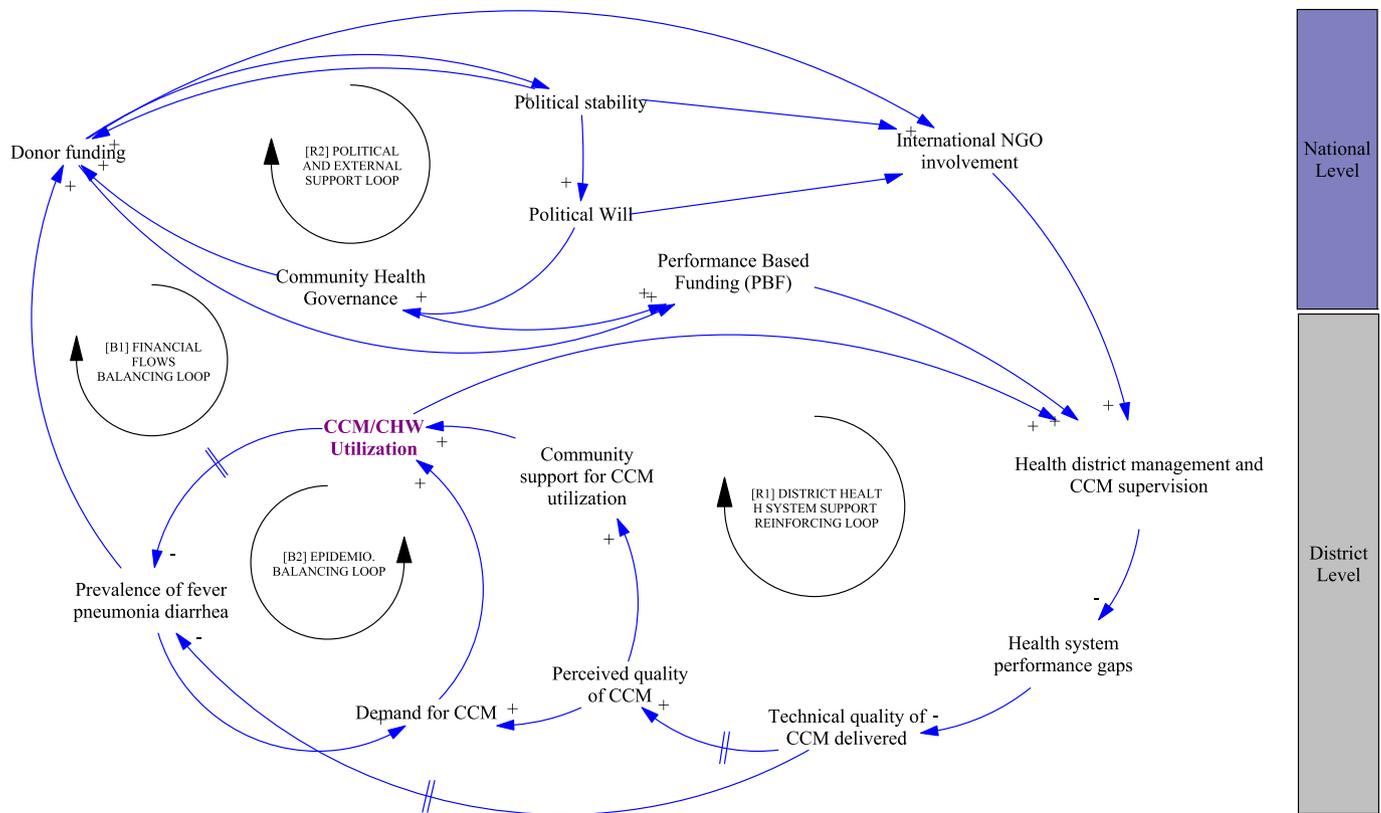


Fig. 1. Causal loop analysis of iCCM sustainability determinants.

This brings us to the national level and the importance of *performance-based funding (PBF)* as an engine to support performance, supervision, data flows, and problem solving at all levels. The recent documentation of the scale up process of iCCM in Rwanda (Mugeni et al., 2014) attributed at least part of the success to the creative use of PBF at community level, and cited nearly a dozen other publications as demonstrating “high rates of appropriate management of pediatric pneumonia, diarrhea, and malaria by CHWs.” In a study where districts were paired and assigned randomly in Rwanda, the probability of a facility delivery increased by 10 percent points in intervention (PBF) versus control districts (Priedeman et al., 2013). The authors concluded that PBF can show positive results when service use is uniformly low. Another pseudo-experimental PBF study in Rwanda at facility level showed even higher increases in institutional deliveries, preventive care visits by children 0–23 months, and children 24–59 months (Basinga et al., 2011). Authors however concluded that PBF in Rwanda “had the greatest effect on those services that had the highest payment rates and needed the least effort from the service provider.” On the same cautious side, a review of 22 CCM USAID projects from 2000 to 2012 (Marsh et al., 2012) finds “decreasing returns from CHW cooperatives and other sources for Performance-Based Financing.” Finally, a synthesis of 12 systematic reviews ((Oxman and Fretheim, 2009) in (Montagu and Yamey, 2011)) found “limited evidence on whether pay-for-performance could help achieve the MDGs” and that “financial incentives aimed at patients and individual providers are effective over the short term for ‘simple and distinct, well-defined behavioral goals.”

Where the wisdom ultimately lies in PBF is beyond the scope of this paper, but delivery of CCM services, information and commodities have been part of the discrete defined tasks supported by PBF in the implementation of iCCM in Rwanda. As described:

“community health workers are organized into cooperatives, which meet monthly in each sector. The MOH disburses funds to these cooperatives once per quarter on the basis of key health indicators, including number of households using insecticide-treated bed nets, appropriate management of diarrhea-related dehydration, and accurate data reporting in iCCM registers.” (Mugeni et al., 2014).

Income from PBF, throughout the health system is substantial enough for at least some CHWs to speak about “buying” and “selling” indicators (Sarriot & Kabeho Mwana Final Evaluation Team, 2011). Detailed analysis of the distribution of PBF monies is beyond the scope of this work, but they augment the income of MOH staff and now reach the community level. If we follow carefully the district to national and national to district chain of effects on PBF, we can map out a *financial flows* balancing loop [B1], whereby health improvements and reduction in disease prevalence resulting from the success of iCCM can ultimately lead to a reduction in donor funding, and hence in PBF resources.

There remain two major variables to account for in Fig. 1. *Political will* for community health translates into dynamic *community health governance* and leadership from the central levels of the MOH, which have coordinated institutions such as the National Malaria Control Program and the Community Health Desk for example. This translates into active monitoring of district performance, and a proclivity toward policy interventions to address emerging or threatening problems. This *political will*, bolstered by *political stability*, has energized *PBF* and *health district management*, but also encouraged *donor funding*, and almost certainly contributed to *community support for iCCM*.

The presence of international NGOs in the Rwandan districts and their support to national development policies overall is an additional variable of interest, playing a supportive role at district and community level. The Kabeho Mwana evaluation noted a

number of positive signs in terms of autonomy and ownership by the district teams, but also acknowledged that the project had been a substantial, if facilitative, presence on the ground. In the scale up of iCCM, the MOH has established community health supervisors in all health centers, nationally. This is a remarkable step and commitment from the government. Community health supervisors nonetheless reported logistical and time challenges in implementing supervision, and came to rely heavily on the cell coordinators (themselves CHWs) and the CHW peer group structure, supported by the NGO coalition. Not all districts in Rwanda receive the same support, and not all NGOs intervening in the country have necessarily had the flexibility and the level of close alignment, which the three NGOs demonstrated. However, capacity building interventions of NGOs, UN and bilateral programs are a recognized part of the way in which health systems initiatives are supported.

At a high level, Fig. 1 reveals four major loops. (Figs. 2–4 show these feedback loops isolated from the full diagram to make their identification easier.)

These loops are labeled “B” when they are balancing and “R” when they are reinforcing: District health systems support iCCM utilization, a success which encourages momentum for district health systems [R1]. Political will and external support converge to provide resources and support to health districts and ultimately communities, through a community health strategy [R2]. Financial flows are essential in this and are supported by political stability and effective governance of community health. But these are negatively affected by reduction in absolute needs (child morbidity) [B1]; these needs are themselves in an epidemiological balancing loop<sup>1</sup> [B2], whereby effective disease control leads to decreased demand for and utilization of iCCM.

This presents the question of sustainability as a system struggling for positive momentum and equilibrium, rather than a state to be reached (Sarriot and Kouletio, 2014). We now consider three main scenarios which combine both high probability of occurrence and high risk for shifting the current dynamics of the system. In each case, we describe the scenario, suggest mitigation strategies and attempt some recommendations.

#### 4.1. Scenario #1—Reduction in external financial support to Rwanda, with reduction of resources for PBF occurring too fast for sustainable local solutions to emerge

Total health expenditures in Rwanda were at 10% of GDP in 2008 (Health Systems 20/20 Project, 2011). Donor spending on health was estimated at 38% (Sub-Saharan Africa average of 21%), and users' out of pocket service charges represent 24% of total health expenditures (Sub-Saharan Africa average of 38%). This leaves an important level of effort and commitment required from the national government and the national health insurance system. The health sector remains however dependent on external funding, particularly when it comes to PBF, which is almost exclusively supported by the Global Fund for AIDS, Tuberculosis and Malaria.

The scenario of decreased external financial assistance, with tightening in PBF funding in the next two to five years is easily conceivable given the aftermath of the global financial crisis, plateauing of Global Fund resources, as well as European and US budgetary commitments. The commitments of Overseas Development Assistance (ODA) for Rwanda have oscillated substantially from year to year in the last four years, after periods of steady

increase, and have been under threat of a freeze recently due to political regional tensions.

The causal loop diagram does not detail all the variables affected by the shrinking of PBF funding, but it summarizes the chain of causality from reduced PBF funds to further gaps in the health system performance. The shrinking of PBF will naturally lead to competition for its resources; and would also negatively affect the motivation of workers who have come to depend on small but regular funds as part of their livelihood. Skilled cadres in the health system may also be enticed to make career changes. Without PBF incentives, the flow of information from community, facility and district levels could suffer at the same time as central level capacity to address gaps in performance is affected. Without a steady flow of information and with reduced financial incentives, workers' performance is likely to degrade. Commodities security including for community health drugs depends on skilled and motivated staff, and stable funding. Stockouts, which were rare but not nonexistent at the time of the Kabeho Mwana project evaluation, could occur more frequently and give more weight to the *health system performance gap* variable.

#### 4.1.1. Mitigating strategies and suggestions to health system stakeholders

The risk associated with PBF and external assistance is obviously not novel. Cooperatives of CHW's have been promoted by the government in part to mitigate the risk on community PBF and the government has taken the step of hiring a business consulting firm to support their viability (Mugeni et al., 2014). Whether these cooperatives can evolve from recipients of funding to generators of income in a timely fashion remains at this point an unanswered question. And regardless, for MOH staff, even increased government commitment to health sector financing would only cover a small fraction of what is currently provided through PBF.

We have no simple remedy to offer and this requires more careful analysis. We suggest:

- The mitigation of this risk needs to be addressed urgently, explicitly, and collectively by the government of Rwanda (both central and decentralized structures) and all its development partners. Early anticipation of necessary forthcoming policy changes are essential for the system to adapt. This will require creating alternative strategies, which, from a complex systems perspective, are more likely to emerge through a decentralized and participatory process, with room for trial and error (Axelrod and Cohen, 2001; Miller and Page, 2007).
- Donors should commit to a realistic timeline allowing preparation and adaptation. Realistic could mean 10 or 15 years, but is certainly longer than typical project lifespans. The commitment and cost that this represents should be placed against the greater cost of not allowing local adaptation and reversing the current positive trend (Longer term, phased donor commitments could possibly give more room for local expression of capacity and adaptation (Sarriot et al., 2010)).
- In the long run and beyond the particulars of Rwanda, human resource specialists and policy analysts may want to work with anthropologists and human dynamics researchers to consider the sustainability of PBF in and by itself, within the broader context of the compensation of labor and financial incentives for routine performance. For example, in a context of increased experimentation with systems tools of research, agent-based modeling of health system behaviors under different motivation schemes, could usefully make use of organizational and anthropological data to study long-term expectations of health system behavior.

<sup>1</sup> Improvements in care seeking and treatment can reduce disease prevalence by shortening natural history thus reducing transmission rates, but cannot be assumed to be the sole factor – environmental and immunization factors have been added in the Web Annexes.

#### 4.2. Scenario #2—Loss of momentum and political will following natural political/electoral cycles of change, when much rests on a small group of charismatic leaders with high visibility

The second scenario is based on: (1) the recognition of the importance of political will and the strong drive for reform, results, and adaptive management, expressed from the highest level of the political pyramid and then through the layers of the Rwandan health bureaucracy; and (2) the knowledge that the country faces elections in 2017. The Rwandan Constitution limits presidential tenure to two terms. Consequently, the changes demanded by a viable democracy will also come with substantial leadership and possibly political changes for the country.

The Kabeho Mwana project evaluation included the now nearly mythical photograph of President Paul Kagame, in the national stadium, waving to a crowd of 30,000 CHWs in 2008. It is legitimate for community health systems stakeholders to both be motivated by this unique level of commitment, and to ponder the implications of political changes on the horizon. Again, the chain of causality can be followed from the political stability variable to show both upstream (funding) and downstream (health system performance) effects.

##### 4.2.1. Mitigating strategies and suggestions to health system stakeholders

We do not discuss political issues, but seek to identify potential shocks to a still developing community health system and infrastructure. The main mitigating factors for these political changes on the horizon lie with the skills, competencies and distribution of health cadres and professionals within the system, a distribution traditionally referred to as decentralization.

Without decentralization, a health system can be schematically represented as a single hub and spoke structure, where command and control lies at the center, and the periphery only has implementation capacity. A weakening of the center can lead to a collapse of the system. Through effective decentralization, governance, leadership, organization, staffing, financial management, and human resource management capacity can become manifest not only at the central but also peripheral hub levels. This can lead to a health system that is more complex but also more resilient.

The most useful recommendation is possibly to accelerate decentralization, with a focus on real-time health management information systems, governance, accountability, and management problem solving skills. Diversification of the type of actors in the health system, for example through district-NGO partnerships for specific support functions to community health, may also be considered as a means of strengthening resiliency and adaptive capacity. One of the positive lessons from the Kabeho Mwana project evaluation was the value added by the project as a *district-level* technical assistance partner. The Ministry of Health actively decentralized its own cadres in 2005, and might want to consider decentralizing the provision of technical assistance of its external partners.

#### 4.3. Scenario #3—Lack of resolution regarding health system performance gaps in essential health system building blocks (commodities, HIS, supervision)

The third and last scenario under consideration resides in the fragility of achievements in the building blocks or sub-systems of the health system (such as health information systems, commodities' security, and supervision), discussed above. The project evaluation (Sarriot & Kabeho Mwana Final Evaluation Team, 2011) found some positive achievements, along with enduring performance gaps in the district health systems. Neither the MCHIP

comparative study (Tsuma, 2011), nor the documentation of iCCM national scale up (Mugeni et al., 2014) suggest that these issues are less salient in non-project districts.

Supervision systems, for example, face very basic logistical challenges in the *land of 1000 hills*. Kabeho Mwana strongly suggested the value of an original peer-support and peer-supervision structure for Community Health Workers (Langston et al., 2014).<sup>2</sup> These sub-systems or 'micro' factors (manifested at district level and below) are not uncommon for iCCM efforts globally. The USAID review mentioned previously (Marsh et al., 2012) identified as continued threats to sustainability sub-systems elements such as the procurement and supply of community health drugs, and integration of health information into the national system.

Fragile sub-systems tend to get better, or get worse, but rarely stay as they are. Current efforts of the government and its partners appropriately target the community drugs' supply chain, and health information systems, and the government has placed dynamic managers (rather than exclusively doctors) at the helm of districts. None of the data examined suggest that decentralized health systems are fully functional and autonomous, but rather that they are in an ongoing process of structuration, and capacity building with support from central levels. Evolution toward scenarios 1 or 2 would obviously further stress recent achievements.

##### 4.3.1. Mitigating strategies and suggestions to health system stakeholders

There is no magic bullet or "free lunch" in community health (Sarriot and Kouletio, 2014), but in as much as current and new projects build individual and institutional capacity to address these issues, rather than pile up disconnected fixes, they will better mitigate the risk of these sub-system weaknesses.

It is easier to identify a specific performance gap in the health system and to design a project to address a single gap, than to conceive of a system-wide intervention which optimizes each sub-system in a way which strengthens the whole community health structure. A possible recommendation is, at a minimum, for stakeholders to assess any subsystem intervention (HIS, supervision, commodities, etc.) in light of the decentralization policy, the future of PBF, and a viable evolution path for a decentralized health system, as the basis for learning and replication. Rwanda may want to consider novel systems approaches to managing both the complexity of its community health system and the plethora of technical assistance provided (Peters, 2014).

Again, decentralization of expertise from central to field practitioners deserves consideration.

## 5. Discussion

The sustainability of iCCM in Rwanda requires attention now, not in spite of the achievements to date, but because of the value they have provided to the population. It will not be about *keeping things the same*, but about *allowing continued progress*.

We have identified three major scenarios, with potential to negatively shift the evolution of the community health system. These three scenarios make the case that, while fully cognizant of the remarkable achievements of Rwanda, there is no time to invest in patches which do not support a long-term plan.

Partial reports from NGO implementers (not published) and from MOH publications (Ministry of Health, 2012; National Institute of Statistics of Rwanda & Ministry of Health, 2012; Republic of Rwanda Ministry of Health, 2011) confirm the

<sup>2</sup> The final evaluation also suggested social enterprising directions for resolving the logistics of supervision, through solar-charged electric (pedal-assist) bicycles.

decreasing trend in iCCM utilization, already reported in the Kabeho Mwana Evaluation, since 2011. As stated by the MOH report, this is partly due to very good reasons, for example the remarkable decrease in the prevalence of malaria and pneumonia. As access to facilities improves with economic development, there may be a day when treatment by CHWs is no longer a priority, but even then, an overarching community health strategy for prevention and treatment, will remain essential. The community health edifice also will need to remain in place because other stressors (health, but also economic, political, food security or climatic shocks) are likely to act against achievements to-date.

The sustainability question needs to be addressed as being relative and progressive through time (Chambers et al., 2013; Sarriot et al., 2010). The system view of complex equilibrium from Fig. 1 frames sustainability as a dynamic question, in a way which the traditional “after the end of project” perspective does not allow. At this point in time, iCCM remains central to the community health strategy. The health system will be stretched to reach communities with drugs, supervision, and to support data collection under all the scenarios we considered. Consequently, all future community health subsystem capacity building interventions need also to establish, or at least test the kind of long-term partnerships, which will support a resilient community health system, while containing and reducing costs. In addition to addressing technical issues (e.g. community drugs), the government and its international partners should be strongly encouraged to test NGO-district partnerships with clear cost-benefit evaluation questions, to continue strengthening cooperatives, consolidating and advancing local community health governance; and to rigorously evaluate different models for sustaining the CHW workforce. This could entail careful expansion of the role of CHWs, with or without links to food security and livelihood interventions; local NGO or cooperative support to CHW peer groups, or other CHW mobilization and support schemes.

### 5.1. Limitations

In a seminal paper, Richardson (Richardson, 1986) makes the case that while causal loop diagrams have been used as first steps in studying the dynamics of a system, they can over-simplify rate-to-level relationships,<sup>3</sup> and should be used in an expository capacity only, where “causal-loop terms are backed up by the modeler’s certain knowledge of how an actual dynamic model behaved when simulated or solved analytically.” We feel that we are within these parameters, and that the method served its analytical purpose, showing important systems relations with long-term risks.

Risk of bias from the authors—most involved as implementers or evaluator of the Kabeho Mwana project—was mitigated by careful consultation with national and international experts. Convergence of at least some of our main findings with those of independent recent peer and gray publications (Marsh et al., 2012; Mugeni et al., 2014) would suggest some success in managing this threat to reliability.

Our analysis has attempted to be thorough and systemic, but largely used secondary data, primarily from the Kabeho Mwana evaluation. Kabeho Mwana districts could however be seen somewhat as a best case situation, compared to some of their peers not receiving outside assistance. If anything, this makes our analysis of risks on iCCM more acute—not less—for the national community health strategy.

Our analysis was informed by quantitative and qualitative findings, but was itself limited to qualitative elements of analysis. It maps out a series of variables’ relationships and risks, but does not offer quantitative benchmarks to monitor the evolution of the health system. Similarly, while economics and public financing questions are raised, further treatment would require greater attention to the specifics. This limitation is inherent to the method of causal loop diagrams.

Our study emphasized the macro-level view of the community health and iCCM system, whether looking at national or district effects, and only made small forays into micro-level behaviors. For example, we treated ‘gaps in health systems performance’ as one single ‘black box’, without detailing issues identified with supervision, commodities, or health information. We considered the financial risk of decreasing resources through PBF, without breaking down the flow of funds across health systems building blocks, levels, and types of personnel. This fit our level of analysis, highlighting variables and scenarios which will affect *all* districts. It obviously does not mean that *each* district will not need to consider specific challenges with proper attention to the *devil in the detail*. Complexity will increase with the level of granularity of analysis.

While we focused on the major risks at the national level for iCCM, it is important to note that systems effects (macro) can also be produced at the intersection of care takers, CHWs and sub-systems’ behaviors (micro level). We illustrate this with one example from the Kabeho Mwana final evaluation report:

*“CHWs are financially incentivized for reporting home deliveries (sometimes referred to as the “selling” of indicators by community health workers met during the final evaluation), but the bulk of their financial incentives comes from health facilities. Health facility in-charges (“titulaires”) are financially incentivized for eliminating home deliveries. In one sector, the health facility in-charge realized s/he was losing funds due to CHWs reporting home deliveries and weighed on them to stop doing so. Which they did for a while. Later on a visit by a district or national MOH official led to high praises for having eliminated home deliveries.” (Sarriot & Kabeho Mwana Final Evaluation Team, 2011)*

This illustrates the potential of individual strategies bearing systems effects at two levels. If the *titulaire* strategy was able to spread (for example, if his or her peers had observed the personal benefits of the strategy), at some point the health system would suffer from self-organization resulting in misleading information on home deliveries. The second example of a systems effect from individual behaviors is that of the CHWs (in this case, cell co-ordinators) who heard the MOH official report on the data. If CHWs had chosen as their adaptation strategy to stay silent, the evolution toward a systemic blind spot on home deliveries would have been accelerated. As it turns out, the meeting with the MOH official provided an opportunity to correct the misdirection; the CHWs stood up and reported the instructions which they were working under, and this under-reporting was reportedly corrected.

This exemplifies an area where more anthropological and institutional-culture action-research studies would bring useful light to the micro-mechanisms through which community health systems can be strengthened, weakened, or even deviated from their purpose. Overarching lessons learned about strengthening complex adaptive systems—if we accept the premise that community health occurs within nested or overlapping complex adaptive systems (Paina and Peters, 2011; Sarriot and Kouletio, 2014)—may provide valuable guidance in this process (Axelrod and Cohen, 2001).

Finally, authors and reviewers agreed rapidly that our scenarios captured the main risks on the iCCM system. Looking back, the

<sup>3</sup> This possible confusion is solved by restating the terms of Text Box 1 as: “A has a positive influence on B if an increase (decrease) in A results in a value of B which is greater (less) than it would have been had A not changed.”

description of our scenarios might be considered mere “common sense”. This critique is occasionally raised against a wide range of qualitative studies. Scientists and politicians are however not immune to forgetting common sense (and ignoring feedback loops) in their pursuit of perfectly rational strategies from their standpoint. The power of causal loops and scenarios may lie not in unearthing unknown factors, but in making explicit how they combine to produce systems effects, and in encouraging decision makers to avoid blind spots and to take action.

## 6. Conclusion

This analysis is far from exhaustive. What we have shown, however, is the need to not only address subsystems, the specific *building blocks* of the community health system, but to address both large system and subsystem issues at the same time. If commodities, human resources, or health information subsystems are left to struggle and wear out, the larger health system will become overwhelmed by putting out fires, and will have limited standing capacity to deal with future shocks, some of which we have tried to identify. At the same time, the subsystem improvement efforts will be doomed to some extent if nothing is done to address the very probable scenarios—financial and political—which we have sketched.

Rwanda has indeed achieved remarkable results for the health of its vulnerable populations and children. It deserves to address now some high probability major challenges, with a view of protecting and maximizing the benefits achieved to date.

## Acknowledgments

Kabeho Mwana was funded in part by the United States Agency for International Development (USAID) under the terms of Cooperative Agreement Number AID-GHS-A-00-06-0018. It was implemented by Concern Worldwide Inc., the International Rescue Committee and World Relief. This paper followed a four-day ‘writeshop’ organized by the MCHIP project. The contents are the responsibility of the authors only. We thank for their contribution the Rwanda Ministry of Health Community Health Desk, the Ministry of Health professionals and Community Health Workers from the district hospitals, district offices, and health centers in Gisagara, Kirehe, Ngoma, Nyaruguru, Nyamagabe, and Nyamasheke districts. Thanks to Jeff Wasbes of the American Evaluation Association, Sharon Arscott-Mills, Soumya Alva, Natasha Wad, and Reeti Desai for their reviews and assistance.

## Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.socscimed.2015.03.014>.

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