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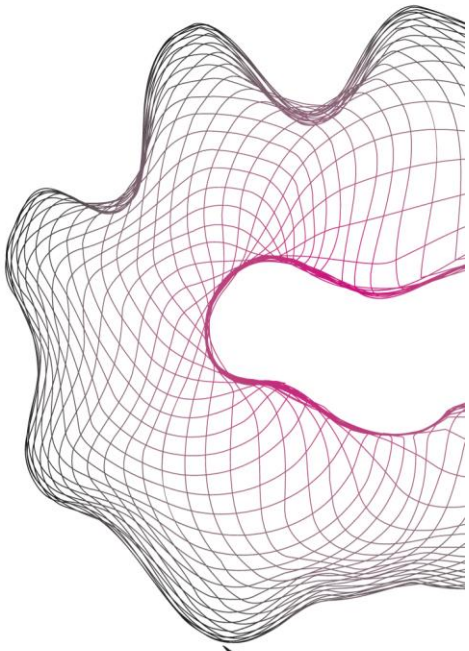

ENTREPRENEURSHIP AS WORKING MECHANISM OF PERFORMANCE BASED FINANCING

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Entrepreneurship as working mechanism of performance based financing

A case study to the diffusion of strategies in Rwandan health centers

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i. Executive summary

i.1 Introduction

Among different payment mechanisms for health care, there is one mechanism that provides an incentive for health output: performance-based financing (PBF). By financing desired outputs the interests of the health care provider can be aligned with interests of policy makers. For low and middle-income countries this mechanism can be an opportunity to increase policy effectiveness. Most importantly, PBF may contribute to reach the millennium development goals (MDGs) by aligning interests. Second, problems in the supply of health care to the population can be overcome: health care staff becomes eager to treat more people and provide better care when financing them on output.

Indeed, PBF is rapidly gaining popularity in the low and middle-income countries. Rwanda has been the first low-income country where PBF has been introduced nationwide. The introduced PBF program was an addition to existing health care financing. With the PBF program health centers receive bonuses for improving quantity and quality of care, based on various indicators. After non-governmental organizations (NGOs) performed small trials in 2002-2005, the government has introduced PBF countrywide in 2006-2008.

To enable research, the countrywide implementation of PBF was divided in two phases. In half of the (non-trial) regions PBF has been implemented in 2006 (phase 1), in the other half PBF has been introduced in 2007-2008 (phase 2). Thus, together with the trial regions (phase 0), there are three implementation phases. With the phase-wise introduction, the research of Basinga et al., (2011) has demonstrated effectiveness of PBF in Rwanda, mainly in terms of increased delivery of health care for pregnant women.

The majority of studies to PBF focus on the effectiveness of PBF. Studies to the working mechanisms of PBF are very limited. Hence, it is unknown which of the many possible working mechanisms result in the effects of PBF. Even while studies to the working mechanisms are important for assessing long-term effectiveness, potential pitfalls of PBF and prediction of effectiveness for other countries.

In this research the relation of entrepreneurship of the health centers with PBF is assessed. Likely, there is an interaction between the two. One, PBF may affect the degree of entrepreneurship and two, the entrepreneurship may contribute to the effectiveness of PBF. First, the effect of PBF on the entrepreneurialism of health centers is evaluated. For this, the emergence of strategies to increase and improve the provided health care is studied. Second, the importance of the entrepreneurialism as working mechanism of PBF is assessed. It is studied how these strategies diffuse over Rwanda and what are important characteristics to influence this diffusion. The quicker the diffusion, the more likely the entrepreneurialism is important for PBF.

To study the diffusion of strategies, geographical aspects of the diffusion of innovation framework are applied. Roughly there are two modes of spatial diffusion, which together can describe most spatial diffusion patterns. These are hierarchical diffusion and contagious diffusion. The hierarchical diffusion is first the spread between actors high in hierarchy and from there to actors lower in hierarchy. With contagious diffusion this hierarchy plays no role, it spreads like an oil stain.

The framework of diffusion of innovation is also used to assess the characteristics that may influence the diffusion and adoption of the strategies. Four main components which play a role in the adoption of strategies can be distinguished. First, there are attributes of the strategy itself. Characteristics of the adopter are the second component. Third are the communication channels which are used for dissemination and valuation of the strategy. The last component is the context in which the diffusion process has a place.

The research performed as explained in the next sections aims to answer what role entrepreneurialism can have in a PBF system. Moreover, important elements in diffusion and adoption will be determined. With this, more clarity on possible long-term effects of PBF can be given, both for Rwanda as for other countries.

i.2 Methodology

In Rwanda there are approximately 420 health centers and 40 hospitals. Hospitals have, besides the health care duties, the responsibility to supervise health centers. In this way, there are clusters of health centers around supervising hospitals. 14 of these clusters were randomly selected, from which 74 health centers were included in the sample. The selection was stratified for the moment of introduction of PBF.

A questionnaire has been directed to the supervisors of the included health centers. Supervisors are hospital employees with the task to supervise health centers. The questionnaire roughly contained two topics. First, some open questions were asked to make an inventory of strategies the health centers are using to improve the health care. Second, with closed questions different items were questioned. These items are components of the different key factors that influence the diffusion and adoption of strategies.

To analyze the influence of PBF on the entrepreneurialism of the health centers an inventory of all new strategies was made. Further analysis was performed when a strategy was mentioned at least twice and related to PBF. This further analysis merely served to study the importance of the entrepreneurship for PBF, indicated by the dissemination of strategies. Therefore, the first stage in analysis was to assess the diffusion of strategies. The pattern of diffusion was analyzed on three different levels.

First, the diffusion within the clusters was studied. The presence of strategies was studied in each cluster and clusters were compared on their “will to adopt”. With this, the influence of the supervising hospitals on the health centers was estimated. This represents the influence of the hierarchy of the health system on the diffusion

Second, the influence of the moment of implementation of PBF was assessed, representing the influence of time on the diffusion. All clusters were categorized on the moment of introduction of PBF, resulting in groups of health centers in PBF 0, 1 or 2. For each strategy was studied in which group of health centers presence of strategies was highest.

Third, the adoption of different strategies on the level of the country was studied. With visual analysis the hierarchical and contagious diffusion was assessed. Further, the importance of both diffusion components in the overall diffusion process was described. Also, closely located clusters were compared with other groups of clusters, to assess differences over the country.

The second stage in the analysis was to identify the factors that influence the adoption of the strategy. This might give insight in factors important for entrepreneurism and thus for the success of PBF. The strategy's attributes were studied for a few strategies and their influence on the adoption was roughly estimated. Importance of communication channels was scored by respondents. Also, for different strategies the communication channels which were actually used for diffusion were assessed. For the different health center characteristics and contextual factors, a χ^2-test (with $\alpha<0.05$) is performed to test their relation with the different strategies.

In addition to the quantitative data collection interviews have been conducted. Stakeholders in different positions and on different levels in the health care sector were approached. Selection was done on basis of convenience. The interview-questions were in line with the questionnaire and the answers merely served as background and in-depth information.

i.3 Results

46 different strategies have been identified out of the 57 questionnaires that have been answered (77%). Thirteen of these strategies met the criteria for further analysis. Five of these thirteen strategies were implemented with and eight strategies without government enforcement. For the government-enforced strategies, the strategies related to community health workers (CHWs) show highest presence. CHWs are health workers from the local community, serving as the first entrance to the health care system. Their most frequently mentioned importance for PBF is the sensitization of the community (83%). For non-governmental strategies, strategies to improve access are important (presence varying between 9-21%), but involving local authorities is most often mentioned (39%).

Of the further analyzed strategies, a difference between clusters in adopting strategies is observed. In 11 of the 14 clusters presence of government enforced and health center strategies are similar. Presence is either for both types of strategies high or both low. This suggests the influence of cluster characteristics on the adoption. The spread over clusters and adoption rate within the cluster corresponds in most cases with the total adoption rate. Only for opening an extra post and the use of a schedule for vaccinations, this is different. Adoption is restricted to a few clusters, but within these clusters adoption rates are high.

The second level of diffusion analysis showed that overall, presence of strategies is highest in clusters where PBF has been implemented in 2006 (PBF-1). In more detail, it was seen for seven strategies (54%) that the presence in clusters where PBF was introduced later (PBF-2) or where a trial was performed (PBF-0) is slightly lower. Five strategies (38%) show similar presence in all introduction phases, although with some small differences. Only one strategy, training of personnel, shows an opposite pattern, with lowest presence in PBF-1.

The third level of diffusion analysis showed there was no unequivocal nation-wide diffusion pattern for the strategies. Nevertheless, elements of hierarchy and contagious diffusion have been identified. There are no evident country-wide differences. However, there are some groups of clusters with substantially higher adoption rates (50%) of government strategies compared to others (29%). These clusters with high adoption rates are often located in the larger cities.

As part of the second stage of analysis, the influence of different attributes of strategies was assessed. Observability, trialability and an advantage for health centers scored high for the studied strategies. Also a low uncertainty for introduction of the strategy seems important. The studied strategies show some complexity in introduction and are also not highly compatible. However, none of the assessed strategies was very complex or incompatible.

Most characteristics of the health center did not show a relation with the adoption of a strategy. However, when a health centers has set priorities, this may have a positive (n=8) relation with the adoption of certain strategies. The most relevant link is between the training of CHWs and having vaccinations as a priority. These show a clear positive relation ($p<0.001$). Some priorities can also have a negative result (n=3), with e.g. a focus on family planning and CHWs doing work at community level ($p<0.001$). The influence of the environmental context is limitedly demonstrated, with density of population as most influential factor.

i.4 Discussion

PBF has positively influenced the number of strategies health centers have developed. There are strategies to improve the quality of care, e.g. training of personnel. But the majority of observed strategies are focused on treating more patients. Examples are taking house visits and involving the CHWs in treatment of patients.

Given the implemented strategies, PBF seems to provide most incentives for improving access, efficiency, performance and to involve community more. However, the spread of these strategies between health centers is limited for the majority of strategies. Especially the strategies that result in much extra work for the health care staff are not adopted widely. For broad adoption, the government has an important role. The most appealing example is their enforcement of community health workers, which has reached a very high penetration. The importance of the government is also shown by the higher adoption of strategies in PBF 1 compared to the earlier trial areas which were without government involvement.

The later introduction of PBF in the PBF 2 health centers still results in a difference in the adopted strategies. Thus, the influence of PBF on the entrepreneurialism of health centers does last at least for several years. Although the effect of later introduction may straighten over time, this cannot be concluded from the observations.

Although diffusion may be limited, there are besides the government different components that influence the diffusion. The district hospitals are important, both for quick diffusion over the country as for adoption of strategies in their region. This emphasizes the influence of the hierarchy of the Rwandan health care system for the diffusion. In contrast, the role of contagious diffusion is very limited. This may indicate the need for more interaction moments between health centers.

The importance of other factors on the adoption of strategies is limited. Of the health center characteristics only the focus of the health centers on specific health tasks is important. For that reason, it is recommended to urge health centers to choose a focus. Furthermore, strategies should be tested on an advantage for health centers, with possibilities for trials. Regarding the communication, the formal meetings and the government play the most important role.

Of the contextual factors it was only possible to test for a few factors, since the contextual data was not available on sector or district level. The population density has shown most relevance, but also the road network may be important. More research to the influence of these contextual factors is recommended.

Although the data collection methods may have resulted in some bias, with standardization it was tried to minimize distortion. In addition, with considerable variety in answers of respondents in the same answering session large distortion of the results is refuted. Thus, the internal validity is reasonably high. With the study sample covering the entire country, extrapolation of results within Rwanda is fair. Extrapolation to other countries should be done more carefully.

i.5 Implications and conclusion

The introduction of PBF has driven the health centers to introduce various strategies to improve access, efficiency, performance and involve the community better. With this, it has been tried to improve the attainment of the population by the health care system. Thus, PBF contributes to the entrepreneurship of the health centers.

Conversely, the degree that entrepreneurialism contributes to the effectiveness of PBF is difficult to estimate. Each health center has some strategies to improve the health care. Some contribution to the effectiveness of PBF is therefore evident. But given the large number of strategies for which diffusion is restricted, the contribution to effectiveness is far from optimal.

Essential in the diffusion of strategies is the hierarchy of the health care system, both hospitals and government. Supervising hospitals are an important element in the 'free' diffusion of strategies. This has resulted in differences between clusters. This may be caused by the decentralized system, allowing variation between regions. By enhancing sharing within and between clusters, the effect of the different strategies may be increased.

For a broad adoption of strategies the government has an important role. Thus, an active government is required to enhance sharing and increase the total effect of different strategies. With this, selection of strategies should mainly be based on the degree of advantage, but also needs to meet sufficient observability, trials and compatibility. Therefore, the Rwandan government is recommended to continue their endeavor. Small adjustments on PBF to ensure continuous entrepreneurialism of the health centers could be one of these endeavors. Another suggestion is to urge the health centers to choose priorities in the care they deliver.

In other research PBF has shown to contribute to the MDGs in the short term. The slow diffusion of the strategies indicates entrepreneurialism not to be the core working mechanism of PBF. However, the effects of this entrepreneurialism are likely to contribute to more substantial effects of PBF. With that, also in the long run PBF will probably contribute to reaching the MDGs. This makes financing on performance a serious option for financing health in low-income countries.

ii. Preface

In front of you lies the result of my research in order to complete my Master in Health Sciences at the University of Twente. I have been given the challenging opportunity to be the first student to graduate on a collaboration project between health sciences and the ITC, of which I strongly hope it will be continued and expanded. Above that, I've had the chance to perform this research in Rwanda, a country in which challenges in health care are urgent, but decisively addressed by policy makers.

It is amazing how many people have helped me with this research, either by contributing to it or by supporting me. Without all these people I would not have been able to succeed with this research. All who have contributed, thank you very much!

First I would like to mention all the people who have taken the time to answer the questionnaire. In my enthusiasm the questionnaire became quite extended, but this has not withheld any of you to answer every question seriously. As data collection is the base of my research, I really appreciate your effort.

To all the people who took time to talk to me, either in interviews or in informal conversations, without you I wouldn't have been able to understand the health care system of Rwanda as I do it now. Also the conversations have helped me for interpretation of the results and understanding what are relevant questions.

I also would like to show my appreciation to the Honorable Minister of Health, dr. Agnes Binagwaho, by supporting my research. Without approving the research, this valuable study would not have been possible. Dr. Adolph Kirenzi, thank you for supporting me in this process of approval! I really admire the drive of the honorable minister and her department, the Ministry of Health, for their never diminishing effort to improve health care in an evidence-based way.

For providing me with a good working place and helping me to make the first steps in Kigali I would like to thank you Vedaste. If it wasn't for you I probably wouldn't have been in Rwanda, let alone that I've investigated the PBF.

I really enjoyed the pleasant trips to Huye, to work there on everything that is spatial in nature. It was good collaborating with you on that, Adrie and Elias. Also thank you Adrie, for making me understand how it works in Rwanda to accomplish things. Without you I probably still would have been waiting.

Many thanks also go to Eugen. By assisting me with the data collection I have been able to arrive at every hospital in the right time and with the right expectations. Besides that, it was a pleasure to travel with you and to see how people our age live in Rwanda.

Then, many people have made my stay in Rwanda an unforgettable experience and I would like to name them to show my appreciation. David and Sammy, I really have enjoyed living with you and seeing the Rwandan life from inside-out. Further my teammates of Flair FC, giving me the possibility to relax in sports and drinking. Then to Anne, Cor, Jean-Max, Pritish and Sara, it was a pleasure to have met you and be friends with you.

Back in the Netherlands I would like to thank my friends for their moral support and interest. Mostly I would like to thank my friends who have taken time to read my report and check it on content and English, being Martijn and Jeroen. And of course I would like to mention my parents, thanks to whom I could do this extra master year. Thank you for making the great experience possible.

Lastly, I would of course like to thank my supervisors. Ellen-Wien, thank you for your never stopping drive to make me think like a geographer. I really hope I've grown into it, at least to some extent. I really valued how you've kept me sharp. Also to you Sherif, thank you. I've really appreciated your enthusiasm, for keeping me on track and your visit in Rwanda was mostly appreciated. Then, Hindrik, thank you for giving me courage every time I was in doubt, for your supportive criticisms and your great understanding for the circumstances. Without the three of you, this research wouldn't have been half as much as it is now.

Then to the reader, I really appreciate you taking the time to read this report. Hopefully the results and conclusions of this research are useful to you, so that it can contribute to your view on PBF and help in the further development and improvement of PBF. Enjoy reading.

Daan de Jong,

June 2012, Enschede

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iv. List of abbreviations

BCC	Behavior Communication Change
BTC	Belgian Technical Cooperation
CHW	Community Health Worker
DHS	Demographic Health Survey
GIS	Geographic Information System
HC	Health Centers
IEC	Information, Education & Communication
MDG	Millennium Development Goals
MoH	Ministry of Health (of Rwanda)
NGO	Non-Governmental Organization
PBF	Performance Based Financing

v. Definitions

Access: The absence of barriers to enter the health care system. Barriers can either be financial, physical, institutional or social. (Culyer, 2005)

Amenities for people: The quality of the amenities of care refers to the characteristics of the setting in which the encounter between patient and clinician takes place, such as comfort, convenience and privacy (Donabedian, 1980)

Cell: 'Building-element' of the sector. Each cell consists of a group of villages. (Mugeni, Ngabo, & Humuza, 2011)

Cluster: A group of health centers with the same supervising hospital

Communication channels: An individual or institution that originates a message and the means by which a message gets from the source to the receiver. (Rogers, 1995a)

Community Health Worker: A variety of community health aides selected, trained and working in the communities from which they come (Lehmann & Sanders, 2007)

Contagious diffusion: Diffusion of a phenomenon that spreads outward from a node or epicenter in wavelike fashion. (Kuby, Harner, & Gober, 2004)

Contextual factors: Factors on which innovations depend and involve in, such that their successful transfer depends on their suitability to the new environments they enter during diffusion. (Wejnert, 2002)

District: 'Build-element' of the provinces, which are considered to be local administration. Each district has at least one district hospital. The districts are further subdivided in sector. (Mugeni, et al., 2011)

Efficiency: Maximizing the output for a given opportunity cost. (Culyer, 2005)

Entrepreneurship: Undertaking innovations in an effort to transform them into economic goods

Equity: An equal distribution of treatments, both horizontally (equal people, equal treatment) and vertically (unequal people, equal treatment). (Culyer, 2005)

Health center characteristics: Variables related to the innovativeness (Rogers, 1995a)

Hierarchical diffusion: Diffusion of a phenomenon from larger to smaller places, leaping over nearby but small places in the early stages (Kuby, et al., 2004)

Innovation attributes: The properties of innovations that may affect the rate of adoption (Rogers, 1995a)

Interpersonal relationship: How well the clinician relates to the patient on a human level (Wyszewiansky, 2008)

Involve community: Ensure participation of the community in health projects

Performance-based Incentive: Monetary payment or other material reward that are provided on the condition that one or more indicators of performance change, that predetermined targets are met or both. (Eichler, Auxila, Antione, & Desmangles, 2007)

Performance incentive: the transfer of money or material goods conditional on taking a measurable action or achieving a predetermined performance target (Eichler, et al., 2007)

Province: Rwanda is built up out of 4 provinces plus the City of Kigali. These provinces consist of 30 districts (Mugeni, et al., 2011)

Quality: optimizing material inputs and practitioner skills to produce health (Eichler, et al., 2007)

Responsiveness to patient preferences: Taking into account the wishes and preferences of patients (Wyszewiansky, 2008)

Sector: 'Building-element' of the district. Each sector has its own health center. Sectors are further subdivided in cells. (Mugeni, et al., 2011)

Spatial diffusion: The spread of some phenomenon over space and through time from a limited number of origins. (Kuby, et al., 2004)

Strategy: the intentional introduction and application within a role, group, or organization, of ideas, processes, products or procedures, new to the relevant unit of adoption, designed to significantly benefit the individual, the group or wider society. (Anderson, De Dreu, & Nijstad, 2004; Lansisalmi, 2006)

Technical performance: The application of current scientific medical knowledge and technology in a given situation. (Wyszewiansky, 2008)

Temporal diffusion: The spread of a phenomenon over time.

1. Introduction

1.1 Performance based financing

Improving health care is for developing countries an important facet in their work towards achieving the Millennium Development Goals (MDG 4 and 5) of which the deadline is approaching (Brenzel, 2009; Montagu & Yamey, 2011). Experience has shown that putting money into the health care system alone is not sufficient; certain barriers, both on demand and supply side, have to be overcome (Montagu & Yamey, 2011).

Among other approaches to overcome supply-barriers for health care there is the Performance-Based Financing (PBF) (Montagu & Yamey, 2011). This financing mechanism is based on the belief that health workers are motivated by financial incentives and will try to maximize incomes (Elridge & Palmer, 2009). Popularity for this approach (also known as result-based financing or pay for performance) has been increasing. The Dutch NGO's Cordaid and Health Net TPO and Norway through the global fund are the main drivers behind this (Canavan, Toonen, & Elovainio, 2008; Oxman & Fretheim, 2009). This has led to 22 African countries in the process of introducing or scaling up PBF (Meessen, Soucat, & Sekabaraga, 2011; Soeters & Vroeg, 2011).

PBF is an approach in which it is tried to provide the (often poorly paid) health care providers an incentive to give more or better care (Canavan, et al., 2008). In the definition of PBF, as given by Eichler et al., (2007): "*the transfer of money or material goods conditional on taking a measurable action or achieving a predetermined performance target*" the incentive is given for certain outputs. With this definition in mind, PBF is applicable in many fields, e.g. health and education. It can also be implemented in many different ways and on different levels (Brenzel, 2009; Oxman & Fretheim, 2009; Witter, Fretheim, Kessy, & Lindahl, 2012). This study will however focus on PBF for health facilities.

Since PBF is used as a strategy for reaching the MDGs, there is much interest in the effectiveness of this strategy (Sekabaraga, Diop, & Soucat, 2011). However, research on PBF for health facilities in developing countries is still limited. Only a few rigorous studies on PBF have been done, with weak evidence (Canavan, et al., 2008; Oxman & Fretheim, 2009; Witter, et al., 2012). This is, partly, caused by the fact that implementing PBF is normally a package of interventions of which the effects are difficult to disentangle. With a randomized controlled study in Rwanda, Basinga et al., (2011) succeeded to overcome this problem and demonstrated a positive effect on the number of facility-based deliveries (Montagu & Yamey, 2011).

With the article of Meessen et al., (2011) a new dimension is added to the PBF discussion. It states that PBF is not only useful as a financing tool, but can help in reforming the health care system in a comprehensive way, thus becoming a reform tool. In a roundtable discussion in which Ireland et al., (2011) question this use of PBF as a reform tool, they point out that evidence for PBF is only applicable to Rwanda. Therefore, they suggest more research to why and how the intervention is working (Ireland, Paul, & Dujardin, 2011), on which Macq et al., (2011) and Basinga et al.,(2011) agree. This recommendation is embraced in this study by doing further research to the effects of PBF for the entrepreneurialism of health centers.

1.2 The case of Rwanda

Rwanda is a small, densely populated country with one large city, a few smaller cities and a large rural area. Livelihoods of most Rwandans are agricultural, mainly by rain-fed crops like coffee. Poverty is high, 59.9% of Rwandan people is living below the poverty line (Pose & Samuels, 2011). There is a strong government, with a well-organized decentralized governing system, with high community participation.

The civil war and the genocide of 1994 have destroyed the health care infrastructure. This has made that the health care in Rwanda has to come back from a very low base level (Pose & Samuels, 2011). Many improvements are made, but challenges remain on most areas (Kalk, 2005). In line with other African countries Rwanda is faced with the burden of both communicable and non-communicable diseases (Sambo, Kirigia, & Ki-Zerbo, 2011). In the recent published DHS report, fertility and family planning, but also maternal and child health and mortality are points of attention (NIoSR, 2011).

The rebuilt health care system has a clear hierarchical system, as shown in Figure 1. Entrance for patients to the health care system is via the community health workers (four in every community) or the health centers (Pose & Samuels, 2011). As shown in Figure 2, the health centers are quite evenly distributed over the country, almost in every sector a health center is present.

To overcome barriers on the supply side of the health care system, Rwanda has implemented PBF nationwide, becoming the first African nation with PBF implemented by government. The PBF system of Rwanda is based on three experiments performed in different regions of Rwanda, each driven by a different organization (HealthNet, Cordaid and BTC). Elements of these trials were used for the national model. A set of indicators has been established, both on quantity and quality factors. Every three months a team from the hospital comes to the health center to evaluate the quality factors and calculate a score out of this. Quantity data is entered in an internet-connected database and is validated by data agents (Rusa & Frische, 2006; Rusa et al., 2009).

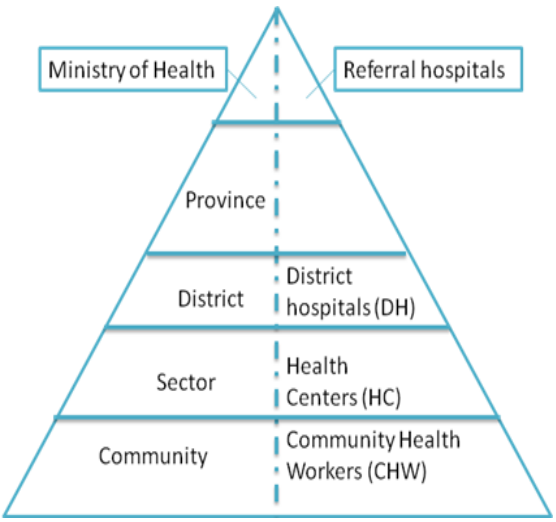

Figure 1: Health care system of Rwanda.
Left are the administrative levels from highest to lowest in hierarchy. Right the different health facilities, matching with the different administrative levels.

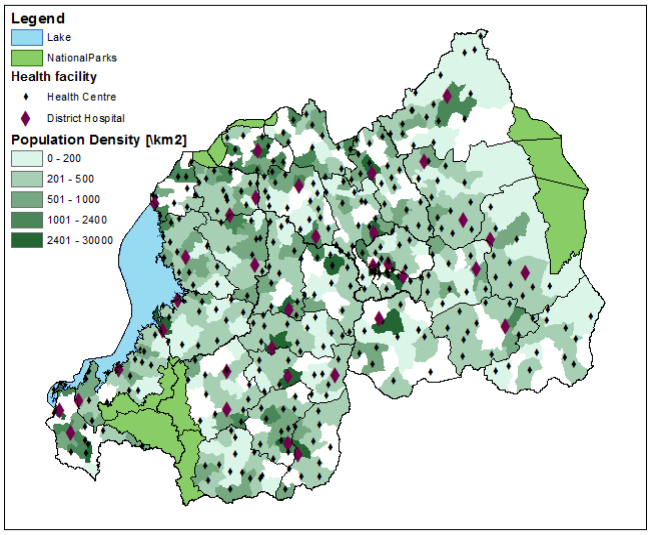

Figure 2: Overview of health facilities in Rwanda.
All dots represent a health center. Population density of the different sectors is displayed as well.

Since research into PBF is scarcely found (Oxman & Fretheim, 2009), the nation-wide implementation in Rwanda has attracted many researchers to study the effects of PBF. Various studies to the trials and nation-wide implementation have therefore been done. Different objectives and research designs were used, varying from before-after comparison (Meessen, Musango, Kashala, & Lemlin, 2006) and randomized controlled trial (Basinga et al., 2011); from regional studies (Soeters, Habineza, & Peerenboom, 2006) to nationwide studies (Kalk, Paul, & Grabosch, 2010). Most focus in these studies is on the outcomes of the PBF. This study has a different focus, as described in the next sub-section.

1.3 Strategies

Suggested by Ireland et al., (2011) more research is needed to why and how PBF is working. Since Rwanda is the only case where the effectiveness of PBF has been demonstrated, this is the logical choice to study further. Although some research has been done to possible working mechanisms (Kalk, et al., 2010), not much quantitative studies have been done.

There are various working mechanisms which are thought to play a role in the effect PBF has on health care. Important is an increased motivation of the health care staff, which makes them work harder (Elridge & Palmer, 2009; Witter, et al., 2012). The central working mechanism in this study is the increase of the entrepreneurial spirit (Kalk, et al., 2010). It is thought that this spirit would result in strategies to better meet the PBF indicators and in that way earn more money. Therefore, these strategies are the object of study.

It could be expected that developing new strategies will result in more sustainable effects compared to the probable main working mechanism of the increased motivation. This would also give possibilities to change the PBF-indicators (Witter, et al., 2012). In this way PBF would become a tool for continuous improvement, instead of a one-time effect. This research therefore focuses entirely on the strategies health centers have developed to improve care.

To study the emergence and diffusion of the strategies the diffusion of innovation framework is most appropriate. Innovations, as defined in Anderson et al., (2004, p. 148) are: *the intentional introduction and application within a role, group, or organization, of ideas, processes, products or procedures, new to the relevant unit of adoption, designed to significantly benefit the individual, the group or wider society.* Three aspects can be seen in this definition. There is an inherent application component (thus not simply work harder), there is an intended benefit and it is new to the unit of adoption (Anderson, et al., 2004; Lansisalmi, 2006).

Strategies which are central in this study do to a large extent meet those criteria. Although they might not be new to all health centers, the changing circumstances have resulted in an extra benefit. Also, it will be observable for other health centers; for some of those it will be perceived as new. Lastly, the application component can easily be judged, in most cases there is a clear difference between application and a change in attitude.

1.4 Objectives

The first objective is to get an overview of the different strategies that are, driven by PBF, introduced by health centers to improve their quality and increase the quantity of care they deliver. Since Basinga et al., (2011) have shown effectiveness of PBF only for the number of facility-based deliveries and because maternal and prenatal deaths are part of the MDG, strategies for improving prenatal and delivery care play an important role in this study. Next to this, other care aspects like growth monitoring, vaccinations and family planning are studied, since also here are supply challenges. This provides an answer on entrepreneurialism as an effect of PBF.

The second objective is to study the diffusion of the different strategies over the country of Rwanda. Interesting is then whether the strategies diffuse and if there is a certain pattern in the diffusion. This helps both in answering on how the strategy is working, but can possibly also give insight in why a strategy is working well or not. Where the first objective provides looks to the effect of PBF, this second objective is opposite and studies whether entrepreneurialism has a substantial effect on the positive outcome of PBF. Thus, to meet this objective the effect of entrepreneurialism on the positive outcome of PBF is assessed.

The third objective is to study the characteristics that influence the adoption of the strategies in the health centers. This is important to further study the mechanisms of the different strategies. Also, determining the influence these characteristics have on successful adoption of strategies can make it possible to derive indicators for prediction of successful implementation in other countries.

To enable the study to the diffusion and adoption of the strategies, the framework of diffusion of innovation is used. This framework is further described in the following subsections. In section 1.5 the characteristics that may influence diffusion are discussed. These are identified from the sociological perspective on the diffusion of innovation framework. To study the diffusion in space and time a geographical approach of the framework is used, as described in subsection 1.6.

In summary, to meet all objectives, for the first objective an overview of strategies is needed. In the second objective a study to the diffusion of these strategies is needed, both spatially and temporally. Last, from many characteristics the influence on adoption (and thus diffusion) of the strategies has to be found. Thus, in this study the emergence and diffusion of strategies developed in order to achieve the PBF criteria are studied, with a unique combination of applying of both the geographical and sociological component of the framework for diffusion of innovation.

1.5 Sociological diffusion of strategies

Since a study to the diffusion of strategies is required for this research, the framework to study diffusion of innovations is used. In this, the health center strategies are considered to be equal to the innovations as discussed in this framework, thus to prevent confusion, from now on only 'diffusion of strategies' will be used.

Origins of the framework of diffusion of strategies lie in the sociology. An important element in this sociological framework is which factors influence the diffusion of strategies. Based on the framework, the adoption and diffusion of the strategies is expected to depend on four key factors as shown in Figure 3 (Atun, Kyratsis, Jelic, Rados-Malicbegovic, & Gurol-Urganci, 2006; Rogers, 1995a; Wejnert, 2002). All of these factors consist of many attributes influencing the diffusion, of which a short overview will be given.

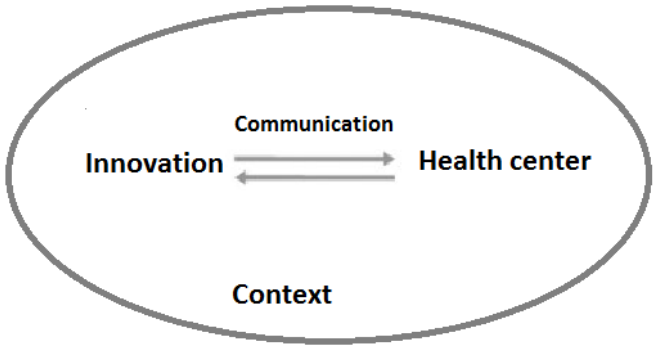

Figure 3: A framework for the key factors of diffusion of strategies in health systems. Adopted and adjusted from Atun, et al., 2006

The first factor regarding diffusion includes the strategy's attributes. For example, when the implementation of a strategy requires a big investment, this will influence the diffusion of the strategy substantially. Rogers, (1995) describes five main attributes, being relative advantage, compatibility, complexity, trialability and observability. Other attributes could for example be the uncertainty around the strategy.

A second factor that can influence the diffusion contains the health center characteristics. It can for example be expected that there will be a difference in diffusion between faith-based and governmental-based health centers, due to a different value system. Where for example distributing condoms for family planning would be a good idea in a government-based health center, it is not in line with the values of the faith-based organization.

Third, there are communication channels that are expected to play a role. There are different kinds of meetings, which could differ between the districts. Also frequency of the meetings and which bodies are represented can affect the likelihood and suitability for diffusion. There can also be other communication channels that play a role.

Last, there is the environmental context that plays a role. For example, there might be a difference between rural and urban health centers, e.g. when extra personnel are attracted. It is already seen that a large share of the health care personnel lives and works in Kigali, increasing difficulties for

health centers in rural areas to attract and keep their personnel. Also population density could influence the advantageous effects of the strategy, and thus play a role in adoption of a strategy. For studying these contextual factors, looking into grouping might be useful for identifying regional differences, e.g. when the influence of provinces is not similar. There are however also influence factors which are not necessarily regional but bound to a health center. A good example of this is differences in access roads to the health centers, which can have a large influence on how a health center is functioning.

1.6 Geographical diffusion of strategies

One of the major research traditions in diffusion of strategies is that of geography, with Hägerstrand as the founder (Hägerstrand, 1953). The roots of social geography in general lie in the fact that social groups are not evenly distributed over space. People move, but they do not move equally in all directions. There can be barriers, like a forest to come from point A to B, while from point A to C there are roads. Also there can be hierarchical influences, people rather move to larger settlements than to small villages. These assumptions are the basis of the geographical approach to the diffusion of innovation framework.

For the diffusion research from the geographic point of view, there are generally two regularities for diffusion. First, there is a contagious effect. In this, the diffusion depends on distance between the origin, the closest are usually affected first, and can be regarded like a spreading oil stain. Second, there is a hierarchical effect. This can be best understood when speaking of cities. Phenomena often diffuse first among the large cities and from these large cities spread to medium cities, and then to the smaller towns, as is shown in Figure 4 (Kuby, et al., 2004). In practice, often a combination of these types of diffusion is seen.

When modeling the diffusion, diffusion both in space and time can be observed (Shannon, Bashsur, & Metzner, 1971). At different time moments, diffusion can be seen within clusters of health centers, but also between clusters. In real life, monitoring during introduction is almost impossible due to the high costs (Rogers, 1995b) and thus often only one or two moments are considered when studying the diffusion pattern, complicating analysis in time.

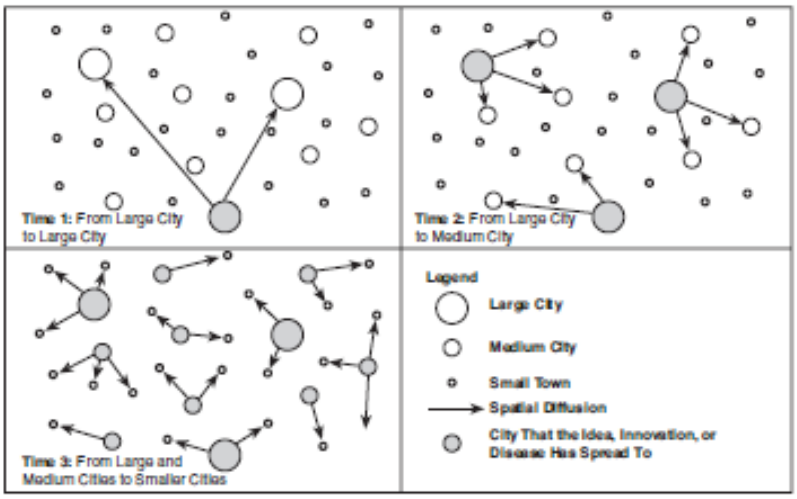

Figure 4: Typical sequence of hierarchical distribution. Adopted from Kuby, et al., 2004

2. Methodology

To meet the research objectives as described in section 1.4, reviewing literature was not sufficient. Therefore, with a field research the data was collected that is required to answer the research questions. There was chosen for a combined approach of quantitative and qualitative data collection. The main reason to perform qualitative data collection was to overcome possible leaps in knowledge. Existence of these leaps was likely as the primary researcher is only limited familiar with the Rwandan health care system. Thus, with the qualitative data it is tried to complement the quantitative results and overcome leaps in knowledge, a sequential explanatory approach (Adamson, 2005). In the following subsections, methods of data collection, sampling and analysis are described.

2.1 Data collection

Quantitative collection

Data was collected through a printed survey, directed to the supervisors of the health centers. Data collection has been performed in January 2012. The questionnaire has been developed in English and was translated into French. Both versions were available; the respondents could choose their preference. All respondents signed informed consent.

The questionnaire covered all four key-characteristics of the diffusion of innovation framework as described in section 1.5 (Atun, et al., 2006; Greenberg, 2006; Rogers, 1995a; Wejnert, 2002). The measured indicators were retrieved from literature (Table 1). To cover all important elements of the indicators, it was often necessary to formulate more than one question (Table 1). For the contextual characteristics also secondary data was used.

The questionnaire was drafted in line with recommendations from literature (Bourque & Fielder, 2003). Of the four sections the questionnaire contains, the first section contains questions about general information on the health center, providing a good entrance for the questionnaire. In section two, with open questions an inventory is made of the strategies the health center is using to reach various PBF-targets. One of these strategies is questioned in more detail in section three. In the fourth section there are questions to determine the health center characteristics, some contextual characteristics and to get insight in the used communication channels. In Appendix I the questionnaire can be found, in Appendix II more rationale behind the questionnaire is given.

To ensure the questionnaire was well-understood by respondents the questionnaire has been tested. Two persons, a hospital director and a medical doctor have examined the questionnaire and assessed it on comprehensibility and suitability to be answered by the supervisor. Based on this, some changes had been implemented, e.g. instead of a five-point Likert scale a three-point scale was used.

To increase response rates, the answering of the survey was framed in a small workshop. The survey was preceded by a short presentation about the research and a brief discussion. The presentation gave an overview on the importance and methodology of the research to enable signing of informed consent. The discussion was to get an univocal view on the definition of strategies which was asked about in the second section. Answering the questions was done individually but deliberation was possible. All was done with the primary researcher as back-up for possible questions.

	Source	# of questions on topic
A. Strategy's attributes	(Rogers, 1995)	24
Uncertainty	(Rogers, 1995)	2
Trialability		1
Relative Advantage for care	(Wejnert, 2002)	5
Relative Advantage for Health center		7
Observability		2
Compatibility		4
Complexity		3
B. Health Center characteristics	(Anderson, et al., 2004)	20
Structure		1
Strategy		4
Size		2
Monetary resources		1
Instrumental resources		2
Personnel		4
Culture		5
Hierarchy	(Rogers, 1995)	2
C. Communication	(Rogers, 1995)	21
Frequency		7
Hierarchy in communication		6
Culture in communication		6
Importance of channel		2
D. Contextual characteristics	(Wejnert, 2002)	10
Political conditions		2
Societal culture		3
Infrastructural problems		1
Competition		3
Other		2

Table 1: The four different key factors and (in italics) their indicators that may influence the diffusion and adoption of strategies. From each of the key factors the source in literature is shown in the second column. When the source for certain indicators differs from the key factor's source, this is also added. For each indicator, the numbers of questions asked is shown in the last column.

Qualitative collection

As support and supplementation to the quantitative data, qualitative data was collected through interviews. Other than the survey collection, data was collected vertically along the health care pyramid shown in Figure 1. Thus, interviews were held on national level, district level and health center level. Interviews were held in English and if necessary a translator was present. The interviews were not recorded.

The interview was developed parallel to the questionnaire and shows large resemblance, which can be seen in Appendix III. It merely served to increase insight in possible causalities. The first section consisted of some questions about the work of the interviewee and the relation that work has with PBF. Then, complementary to the questionnaire, there were some questions on what kind of strategies they see the health centers using because of PBF. For a few of the identified strategies the origins and their experience with diffusion was discussed. Last, the influence of different strategy's attributes and health center characteristics was discussed. Depending on the function and place in the health care system of the interviewee, questions had been adjusted to fit their situation.

2.2 Sampling strategy

For the inclusion of the health center supervisors, the hierarchy and the clustering of the Rwandan health care system are used. Also the fact that PBF has been implemented in phases is used in sampling. The phase wise introduction consists of three phases. First, PBF has been introduced as pilots in different regions (Phase-0 areas). To enable the study of Basinga et al, (2011) PBF has been implemented in two more phases. In the randomly chosen half of the remaining districts PBF was introduced in 2006 (Phase-I areas), in the other half it was introduced in 2008 (Phase-II areas).

Since there is interest in the diffusion of the PBF-strategies of health centers, there was chosen for a specialized method, derived from spatial field research for vegetation mapping (Nature Conservancy & Environmental systems research institute, 1994). An overview of the sampling strategy is shown in Figure 5.

Strategies are expected to most likely sprout in the phase-0 areas and could thus be seen as the center where strategies start. For that reason, from the phase-0 district hospitals randomly ~30% was selected (Step 1 → diamonds). Around the selected hospitals a circle was drawn with a radius of 45 km (three times the mean distance between hospitals) in which the diffusion is expected. In these circles there will also be lying other hospitals (Step 2). From these hospitals randomly one phase-1 and one phase-2 hospital was selected (Step 3). Thus, the diffusion in space (within the 45 km) and in time (different moments of PBF introduction) could be studied. The next step was to identify the health centers which are supervised by these hospitals, giving clusters (Step 4). From each of these clusters, half of the health centers as included in the final sample (Step 5). Since some hospitals would never be included (as they are too far away from phase-0 hospitals), also for the phase-I hospitals more than 45 km away from a phase-0 hospital, the same procedure was used (Step 1 → triangles). A more extensive rationale of this strategy can be found in Appendix IV.

With this sampling strategy, three clusters of health centers located relatively close to each other were included, giving a good possibility to study diffusion. Since multiple circles are used, most of the country was covered, ensuring a good overview of all the present strategies and the possibility to analyze environmental characteristics. Thus, this method enables the study of diffusion of strategies but also provides a good overview over the country.

The sampling method has led to 14 included hospitals (out of 40). Half of the health centers supervised by these hospitals are randomly included, leading to a sample of 74 health centers (out of 416), being 18% of the total. The distribution presented in Table 2 shows a slightly overrepresented Western province, with small underrepresentation of the South and North.

Provinces	Number of included health centers	Part of total health centers in that region (%)
Kigali	4	13
South	15	14
West	26	26
North	11	14
East	18	19
TOTAL	74	18

Table 2: The number of health centers included in the sample. In the second column it is shown as an absolute number, in the third column as percentage of the total number of health centers in that region.

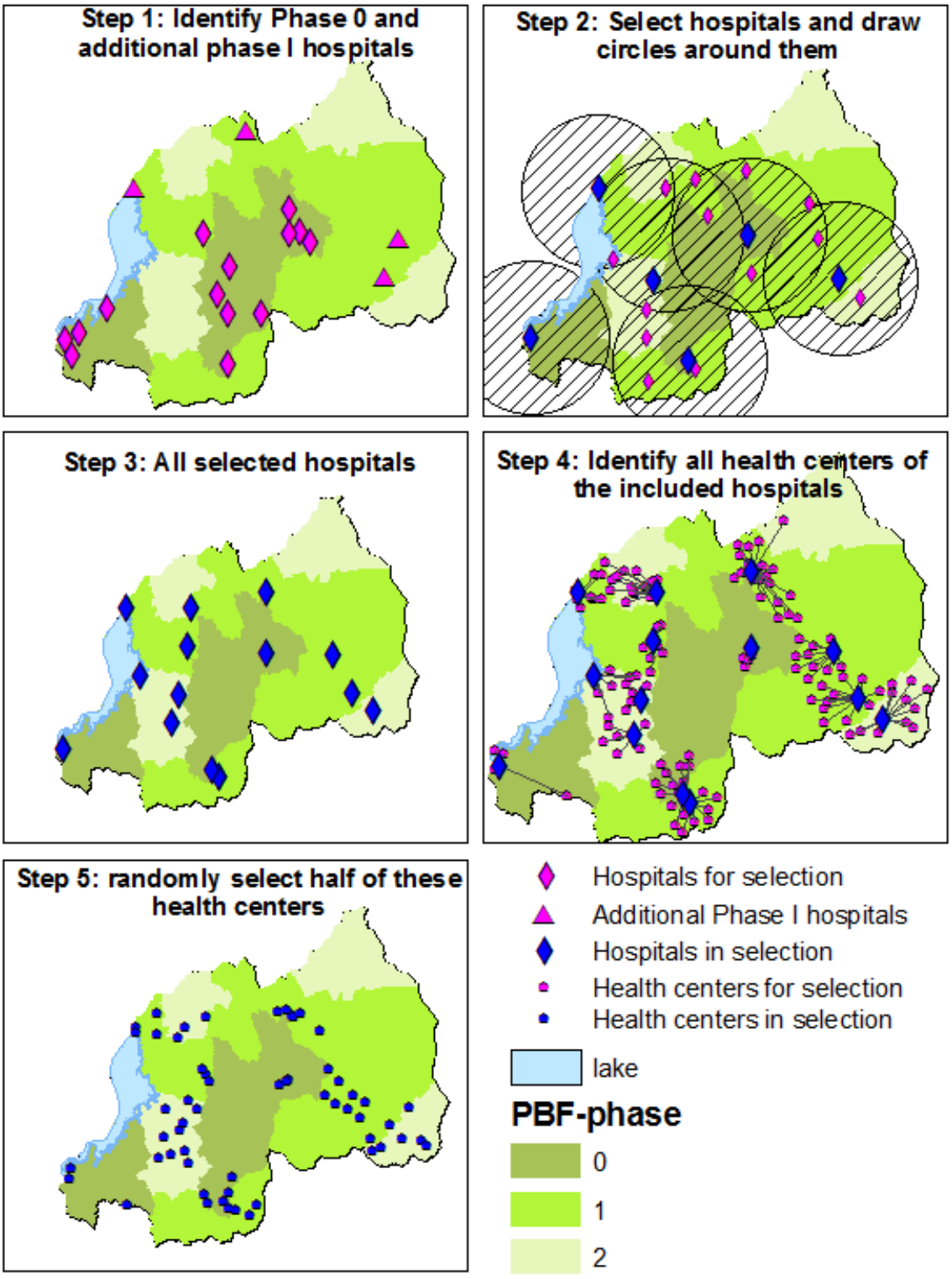

Figure 5: Steps in the sampling strategy Pink are facilities eligible for selection, blue are the finally selected facilities.

2.3 Data analysis

Analysis of quantitative data

All data was entered and analyzed in SPSS, version 16. Some data was exported to ArcGIS to perform spatial analysis. First, all data was checked for outliers. Depending on the cause of the outlier there was decided to accept the data, adjust it (in case of mistakes in monthly, quarterly or yearly data) or to exclude it from analysis. Then the answers were visualized and interpreted.

All mentioned strategies were categorized and classified in the different classes identified as attributes of the quality of care in a broad sense (Ransom, Joshi, Nash, & Ransom, 2008). These classes are expected to cover all possible strategies and it may help for insight in where the challenges are for the health centers.

For all strategies it was assessed whether they are enforced or promoted by government. In that way a clear distinction can be made; what are health centers doing themselves and where is the government needed. Also was assessed to what extent each listed strategy meets the definition of a strategy (see section 'Definitions'). Further, with common sense it was estimated to what extent the strategies are PBF-related, meaning that they are possibly influenced by PBF.

Strategies that are selected for further analysis are those that are listed more than twice, meet the criteria for being a strategy and show a relation with PBF. Further analysis consists of analysis of influencing factors and on the diffusion of strategies. The latter is studied on three aspects: hierarchy, diffusion in time and diffusion in space.

To estimate the influence of the hierarchy, in each group of health centers with the same supervising hospital (a cluster) it was estimated how frequent these strategies were listed. This shows how the different strategies are adopted or not. The next step was doing this the other way around, by analyzing for each cluster what the presence of each strategy is. In that way, the influence of the parental hospitals on the diffusion was studied.

To consider the effect of time in the diffusion of the strategies, the presence of the strategies in the different PBF-phase areas was studied. Since in some regions PBF has been implemented earlier compared to others, these are a look in the future for the other areas. In this way, there could be looked in time how the PBF develops.

The third aspect is the diffusion of the strategies over the country. This is to study whether there is clear clustering in regions and whether there is contagious or hierarchical diffusion. Besides overview maps from which diffusion patterns may be derived, the spread of different strategies over the country was quantified by studying the presence of the strategies in the different circles.

The influence of the identified key factors of diffusion was, if possible, estimated with a χ^2-test with $\alpha<0.05$. This is the case for all questions regarding health center characteristics and some contextual factors. The attributes of the strategy are represented as a high relation, low relation or average, based on the different answers on the questions for each attribute. The presence, use and importance of the communication channels was studied and interpreted without any statistical testing.

Analysis of qualitative data

For the analysis of the interviews, all answers were categorized on topic. For each topic all answers were summarized (see appendix VIII) and the data is used for interpretation and explanation of the quantitative data, mainly by quoting the interviewees. These can be recognized by the quotes in italics. Since the interviews have not been recorded, quotes are not literal but as remembered and interpreted by the author.

Secondary data

A limitation of the primary data collection and analysis was that the questionnaire could not include all contextual factors. To overcome this leap, collecting the results of other surveys is a good possibility. There was searched to different elements of the context. One of the elements that may play a role in how the health centers behave is the regional health situation. Differences in presence of diseases like malaria may affect the policies of health centers. Also regional characteristics like population density, literacy, education, health insurance, employment may play a role. Third, differences in government may play a role. In this research, through government and the institute of statistics, it was tried to retrieve this data as detailed as possible.

Results of this data collection and analysis are shown in the subsequent section. The results of the different objectives are discussed in sequence. First, the identified strategies are presented and explained. This is followed by the analysis on the diffusion of the strategies, on the different levels as described in section 2.3. Third, the results of the different key factors on the adoption of strategies are shown.

3. Results

The questionnaire has been answered for 57 health centers, being 77% of all included health centers. For each cluster of health centers, at least three and maximal six questionnaires have been collected. The respondents were not in all cases supervisors of health centers, e.g. there were also data managers who filled out the questionnaire (Figure 7). On average, the respondents are 3.5 year in their position. Interviews have been held along the health care pyramid, in total with eight people (Figure 6).

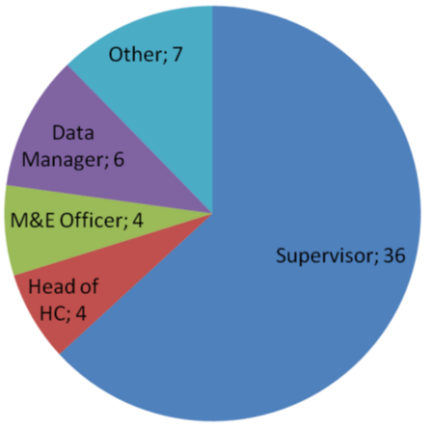

Figure 7: The respondent's position M&E stands for monitoring and evaluation.

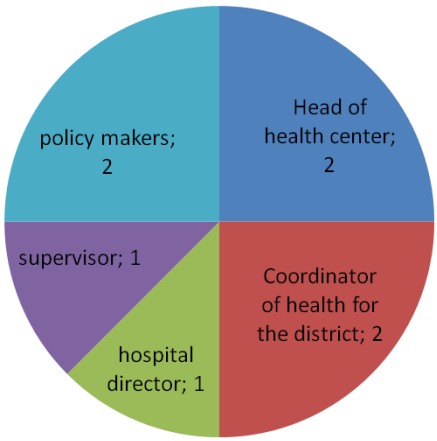

Figure 6: The position of the interviewees

3.1 The present strategies

To meet the first objective there is required an overview of all the strategies introduced by health centers due to PBF. In total, 46 different strategies to improve quantity and quality of care have been listed (Table 3 & Table 4). Thirteen of these strategies are enforced by the government (Table 3). The role of the government is largest on improving access, involving community and giving amenities.

Of the remaining 33 strategies eighteen are non-frequent, being listed only once or twice (Table 4). Of the fifteen remaining strategies, eight do meet both the definition of a strategy and have a clear relationship with PBF. Together with some of the more frequently mentioned government-enforced strategies (>25%), these eight strategies are used for further analysis.

Category	Strategy	Listed (%)	Source
Access	**1. CHWs doing work at community level**	**63**	Pose,2011
	2. CHW-maternal follows woman regularly	28	Pose,2011
	3. Advanced strategy for vaccinations	**26**	Interview
	4. CHW bring back abandoned	19	Pose,2011
Involve community	**5. Sensitization by CHWs**	**82**	Pose,2011
	6. IEC (information, education, communication)	**40**	
Amenities for people	**7. Giving materials**	**35**	Interview
	8. Deliveries for free	11	Interview
Equity	9. Village projects	7	Pose,2011
	10. Reinforcement of Mutual Health Insurance	5	Pose,2011
Technical performance	11. Supervision	5	
	12. Implement protocols MoH	5	
Other	13. PBF	9	Pose,2011

Table 3: Categorization and frequencies (%) of the listed strategies enforced by government. The column 'source' indicates from which source it is known that the strategy is from government. In **bold** are the strategies that are analyzed further.

Category	Name of strategy	Listed (%)	Strategy	PBF-related
Access	**1. Advanced field strategy**	**21**	**+**	**+**
	2. House visits	**12**	**+**	**+**
	3. Extra post opened on other place	**9**	**+**	**+**
	4. Change opening times of posts	**9**	**+**	**+**
Equity	5. Fixed prices	2	-	+/-
Involve community	**6. Involve local authorities**	**39**	**+**	**+/-**
	7. Involve local organizations	7	+	+/-
	8. Sensitize at schools	2	+	+
Amenities for people	9. Motivate with some kind of lottery	2	+	+
	10. Distribute contraception means	2	+/-	+/-
Responsiveness to patient preferences	11. Offer all kind of family-planning methods	4	-	+
	12. Support patients	2	-	+
	13. Clean rooms	2	-	+
	14. Involve husband	2	+	+/-
	15. Providing transport to hospitals	2	+	+/-
Efficiency	16. Having the material on stock	23	-	+
	17. Schedule/timeline	**11**	**+**	**+**
	18. Register and follow patients	9	+	+/-
	19. Follow-up	9	+	+/-
	20. Fixed targets	4	+	+/-
Technical performance	21. Giving high-quality care	23	-	+
	22. Training personnel	**19**	**+**	**+**
	23. Training CHWs	**9**	**+**	**+**
	24. Form quality targets	4	+/-	+/-
Interpersonal relationship	25. Sensitize during visits	35	+/-	+
	26. Warm welcome	9	-	+
	27. Hiring good & motivated personnel	2	-	+
	28. Customer care	2	-	+
Other	29. Revise Benchmarks	7	-	+
	30. Media use	4	+	+/-
	31. Recruitment of good personnel	4	-	+/-
	32. Campaigns	2	+	+/-
	33. BCC (behavior communication change)	2	+	+/-

Table 4: Categorization and frequencies (%) of the listed strategies of the health center. For the category 'strategy' a + means that it does meet the definition for strategy, - that it does not meet the definition and +/- is a doubtful case. For the column 'PBF-related' a + means that there is a clear connection with PBF, - means that there is clearly no connection with PBF and +/- that there is possibly some connection with PBF. In **bold** are the strategies that are analyzed further.

What can be seen is that improving access is an important focus, both for strategies enforced by government and by health centers. Community Health Workers (CHWs) are frequently mentioned for improving the access to health centers (N=28, 63&19 %). The CHWs related strategies may be so important since CHWs are the first entrance to the health care system, very close to the community.

Since CHWs live in the community they serve, they can easily follow pregnant woman and non-healthy people. Also they can help in making people aware of possibilities for prevention, or to bring people to health centers. Traditionally there have been some regional differences in how CHWs were deployed. A good example is that there were some districts in which: "*CHWs were motivated by some money to bring pregnant woman or children to vaccinate".* With the formalization of CHWs by the government, these differences have been reduced. What remains is their important role of improving access to health care and inform the community on health.

Another way to inform people is with the IEC program, being information, education and communication. Health center employees are sent into villages to provide these elements by organizing meetings and trainings. Other than with the CHW-related strategies, this leads to extra travelling and work for the health center employees. Also for other strategies like advanced strategy this is the case.

Initially, the advanced strategy has been a government-enforced initiative to improve the vaccinations of children. On fixed moments health workers move to far-away places, to make sure all children in the sector are vaccinated. This is covered under 'advanced strategy for vaccinations'. As indicated by the coordinator of health of a district: "*Initially, advanced strategy has been a government strategy to reach everyone for vaccination. The district has adopted this and is using it now for many things, e.g. family planning. Also, instead of going to some fixed places assigned by the government, they are now able to reach all cells of the sector"*. This modification is caught under 'advanced field strategy'.

Another strategy from government level is the distribution of materials to patients. After a delivery, some materials are given to the mother who gave birth in the health center, e.g. clothes or soap. Another example is giving materials like mosquito-nets when completing all four vaccination rounds. For this distribution of materials a condition is financing for buying these materials, which is not present in all districts: *"I would really like to go a step further, by giving for example clothes to the babies born here".*

Besides the government, also health centers have developed strategies to improve access. Examples of these strategies are house visits, opening an extra post or extending the opening times of the health centers. Enabling these strategies will all require longer working hours or additional personnel. For that reason, it is very likely a strategy that cannot be adopted easily by all health centers as they have monetary constraints. However, as indicated by a hospital director PBF can contribute to make staff work longer: "*I can really use PBF to motivate people; PBF makes it easier to make them work longer or in weekends".*

Sensitization by CHWs and IEC are government-enforced strategies to involve the village community at the base level. The health centers better make use of the existing hierarchy in villages. They involve the local authorities and local organizations in their attempt to improve health. This ensures similar results with less effort from the health center. This might be the reason that this strategy quite wide-spread for a non-government strategy (N=39%).

To further improve the provided care improvements are made on efficiency and performance level. An example is the use of a schedule and timeline to better inform the children's parents on when the next vaccination rounds will take place. Also training of personnel and CHWs is regarded to be an effort to improve the care. Although this training is not directly rewarded by PBF, the training can increase both performance and efficiency of the employees and thus lead to higher remuneration of PBF.

All of the previous discussed strategies are selected for further analysis. In the next two sections this performed analysis is presented. This analysis will comprise the diffusion of the strategies (section 3.2) and which factors are there to influence this diffusion and adoption (section 3.3). There are also three other frequently mentioned strategies (# = 16, 21, 25), but these did not meet the definition of a strategy. Still, it is remarkable that 23% of the health centers indicated that they now have their materials on stock and provide high-quality care. Although not a strategy, apparently it was not standard to have the materials or to provide good care. In that way PBF has also contributed to improvement of care, making conditions that should be normal a standard.

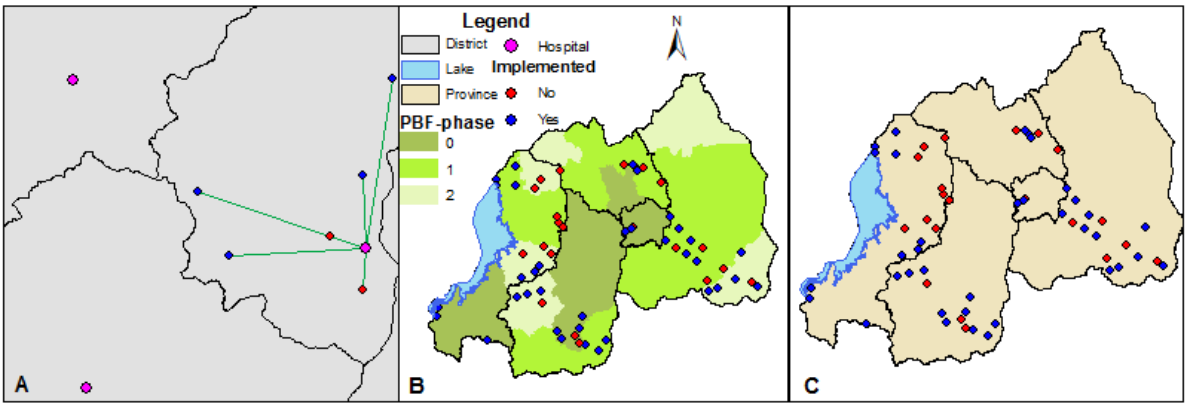

Figure 8: The different levels on which the diffusion of a strategy is studied. A is the diffusion within a cluster and represents hierarchical diffusion. B is the diffusion in the different PBF phases, representing diffusion in time. C is the nation-wide diffusion, representing the spatial diffusion.

3.2 Diffusion of strategies

The results of the first step in the further analysis are shown in this section. The diffusion of strategies is analyzed on different levels, as is shown in Figure 8. With analysis within clusters, between regions with early or late introduction of PBF and analysis over the country different aspects of diffusion are covered. The influence of hierarchy, time of introduction and contagious diffusion can are in this way assessed.

Diffusion within clusters

The diffusion of the strategies can be studied on different levels (Figure 8). For the cluster level (Figure 8A), a two-sided approach is used. One, the different clusters are studied on their openness to strategies. Table 5 shows for the different clusters to what extent (compared to other health centers) strategies are introduced. Two, the adoption of different strategies is assessed on cluster level. To achieve this, it is shown how often and to what extent strategies have been implemented (Table 6). In this way it is studied whether clusters are important for the spread of some specific strategies.

In Table 5 it can be seen in most clusters government-enforced and non-government-enforced strategies are either both above the median or both below the median, with the median being 70% for government-enforced strategies and 48% for non-government strategies. Thus high or low presence does of strategies mostly depend on the cluster. Only cluster 5, 10 and 13 are an exception to this with respectively a high presence of government-enforced strategies and a low presence of non government-enforced strategies (cluster 5) or, conversely, a high presence of non-government strategies with low presence of government strategies (cluster 10&13). This may indicate differences in cluster hierarchy for these clusters compared to others.

The work of CHWs is mentioned in all districts, with the great majority in more than half of the cases (Table 6). For sensitization by CHWs, in six clusters more than half of the health centers have adopted the strategy and in seven clusters all health centers have adopted the strategy, which could be interpreted as a strategy that diffuses strongly within a cluster. Other government measures, being the IEC and advanced strategy for vaccinations, are also mentioned in most clusters (3 & 8), although in half of the cases presence is in less than 50%. This may indicate a weaker diffusion within clusters.

Cluster #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Government strategies (%)	100	87	83	82	82	81	73	66	66	55	50	48	36	27
Non-government strategies (%)	66	67	54	100	40	66	40	40	40	79	26	30	53	26

Table 5: the relative presence of government and non-government strategies in different clusters. 100% is the highest presence of strategies (relative to others) and 0% means no presence.

When in a cluster local authorities are involved (strategy 4), in this is widely diffused within the cluster (6 of the 8 clusters). For opening an extra post and changing opening times, it is remarkable that there is in both cases one district where the presence is >50% or even 100%, even though the occurrence of these strategies is low, with presence only in 3 or 4 clusters. So also for these strategies there is a wide diffusion within the cluster once adopted. Another non-government strategy is the advanced field strategy. This has been implemented in many clusters (9 out of 14). However, different to the previous strategies, within most clusters (8) presence is in less than 50 % of the HCs. This probably means a slow diffusion within the cluster for this strategy.

	The strategy is present in:			
Strategies	None of the HC of a cluster	Less than half of the HCs of a cluster	More than half of the HCs of a cluster	All of the HC of a cluster
1. Sensitization by CHWs	0	1 (7%)	6 (43%)	7 (50%)
2. CHWs doing work at community level	2 (14%)	2 (14%)	7 (50%)	3 (21%)
3. IEC (information, education, communication)	2 (14%)	6 (43%)	5 (36%)	1 (7%)
4. Involve local authorities	6 (43%)	2 (14%)	5 (36%)	1 (7%)
5. Giving materials	6 (43%)	4 (29%)	3 (21%)	1 (7%)
6. Schedule/timeline	10 (72%)	3 (21%)	0	1 (7%)
7. Extra post opened on other place	11 (79%)	2 (14%)	0	1 (7%)
8. Advanced strategy for vaccinations	5 (36%)	5 (36%)	4 (29%)	0
9. Training personnel	7 (50%)	4 (29%)	3 (21%)	0
10. Training CHWs	10 (72%)	3 (21%)	1 (7%)	0
11. Change opening times of posts	10 (72%)	3 (21%)	1 (7%)	0
12. Advanced field strategy	5 (36%)	8 (57%)	1 (7%)	0
13. House visits	9 (64%)	5 (36%)	0	0

Table 6: The number of clusters in which strategies are present in respectively none, less than half, more than half or all health centers. For each strategy in each of the 14 clusters the presence is determined. When in 2 of these clusters the strategy is present at all health centers, the last column becomes 2.

	PBF 0	PBF 1	PBF 2
Government strategies (%)	84	100	86
Non-government strategies (%)	70	100	75

Table 7: The relative presence of government-enforced and non-government-enforced strategies in different clusters. 100% is the highest presence of strategies (relative to others) and 0% means no presence.

Diffusion for PBF implementation-phases

Diffusion of strategies is possible in many directions and in many ways. In this section the diffusion of the strategies in the different directions of PBF phase is assessed (Figure 8B). As discussed in the methodology section, this assessment is a derivative for diffusion in time. With implementation of PBF in PBF 0 during 2002-2005, PBF 1 in 2006 and PBF 2 in 2008, there is some time difference in introduction for the health centers located in the different areas. .

The presence of strategies is highest in PBF 1 regions, both for government and non-government strategies (Table 7). Presence of strategies in PBF 0 and PBF 2 is quite similar, but substantially lower compared to PBF 1 areas. The presence of non-government strategies has a higher difference between the PBF 1 areas and the other areas (~30%) compared to the government strategies (~15%).

To study the effect of different PBF phases more locally there is looked more locally. Within each 'sampling-circle' (Figure 10) it is assessed how the time of introduction of PBF relates to the adoption of different strategies (Table 8). For the government strategies (# = 2, 5-7 & 13) there is clearly a higher adoption in most PBF 1 clusters, with the exception for giving materials. However, for most non-government strategies (# = 8-12) there is an even spread of strategies, in half of the cases (50%) the adoption is higher in PBF 1 clusters and in the other half the adoption is higher in PBF 2 clusters.

Some exceptions of PBF 1 having highest presence of the strategy are also visible. For house visits (#=3) there is a phase-wise diffusion. Highest presence is in PBF 0 and the lowest presence is in PBF 2 health centers. Also for CHWs doing work at the community level, IEC and training of personnel this pattern can be seen, although less prominent. Only for the strategy of giving materials the contrary is visible, this is mostly adopted by PBF 2 health centers.

	Strategies:	PBF 1 > PBF 0	PBF 1 > PBF 2
1.	**Training CHWs**	100%	100%
2.	**Sensitization by CHWs**	67%	100%
3.	**House visits**	0%	100%
4.	**Involve local authorities**	75%	75%
5.	**IEC (information, education, communication)**	50%	75%
6.	**Advanced strategy for vaccinations**	100%	67%
7.	**CHWs doing work at community level**	25%	67%
8.	**Extra post opened on other place**	100%	50%
9.	**Advanced field strategy**	100%	50%
10.	**Schedule/timeline**	67%	50%
11.	**Change opening times of posts**	50%	50%
12.	**Training personnel**	0%	50%
13.	**Giving materials**	75%	33%

Table 8: The diffusion of strategies from PBF 1 areas to closely located PBF 0 and PBF 2 areas. Displayed is the percentage of circles where the presence of a strategy is higher in PBF 1 compared to respectively PBF 0 or PBF 2 in the same circle, with the circles as shown in Figure 10

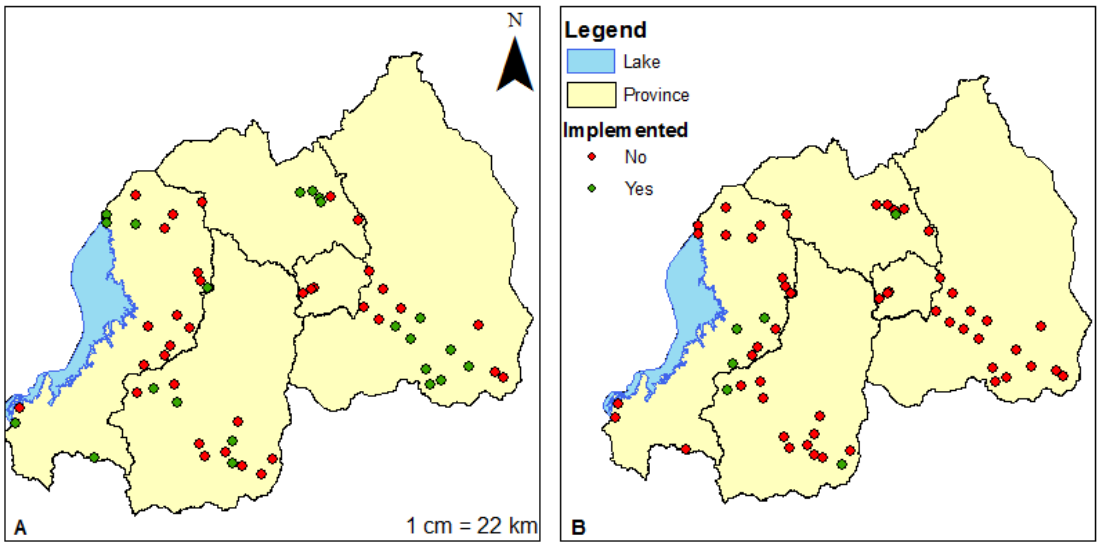

Figure 9: Adoption of two different strategies. A is the presence of the strategy 'involve local authorities', B is the presence of the strategy 'using schedule and timeline'.

Nation-wide diffusion

To continue the line of analysis, nation-wide diffusion is assessed (Figure 8C). As shown in section 1.6, diffusion mainly consists of two components, being contagious and hierarchical diffusion. In Figure 9 there are two maps of strategies that seem to show contagious diffusion, the presence of strategies is present in groups of closely-located health centers. In Figure 9A this can clearly be seen: if there is a health center which involves local authorities, also some surrounding health centers involve authorities. However, the strategy is not focused on one spot. There are various places over the country where groups of health centers that involve the local authorities are seen. This suggests hierarchical diffusion to play a role as well. In Figure 9B there are various places over the country where a schedule and timeline is used for planning of vaccinations. However, only in one region there is a group of health centers where it has been adopted (in the West).

For many other strategies the hierarchical and contagious diffusion is less visible. Therefore, the presence of a strategy is calculated in each circle, as used for the sampling of health centers (Figure 10), and after that aggregated back to either government or non-government strategy (Table 9). In this way the contagious and possible hierarchical spread within regions and over the country is assessed.

What can be seen is that in Circle 4 and 5 most strategies, both government and non-government, are seen. For most non-government strategies presence is highest in circle 5. In circle 4 the same strategies are present but with slightly lower presence. In circle 2 there are less different strategies adopted, but those that are present are more widely diffused.

	Circle 1	Circle2	Circle 3	Circle 4	Circle 5	Circle 6
Government (%)	29	33	37	46	50	46
Non government (%)	12	25	11	16	27	15
# of different non-government strategies	4	4	5	8	8	4
# of different government strategies	**4**	**2**	**5**	**5**	**5**	**5**

Table 9 Average presence of the different strategies aggregated in the different circles. The first two rows present the presence of strategies. In the third and fourth row the number of different strategies are presented.

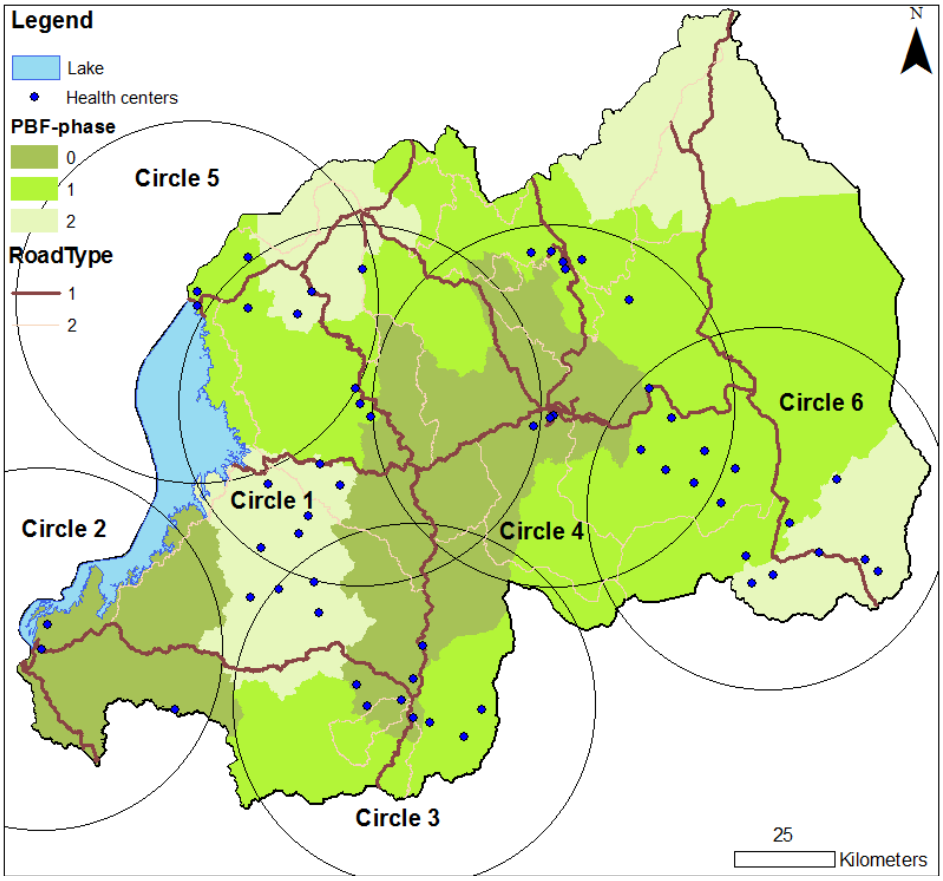

Figure 10: The different circles used for the sampling.

3.3 Influence of key factors

Part two of the further analysis of the selected strategies is performed in this section. The different factors that may influence the diffusion and adoption of the strategies are assessed. These factors were presented more extensively in the methodology section. Roughly they can be subdivided in four key factors: attributes of a strategy, health center characteristics, communication channels and contextual factors. Each subsection describes the results for one of these key factors.

Attributes of strategies

For five different strategies more than one respondent answered questions about the attributes of the innovation. These five are listed in the first column of Table 10. A broad interpretation of the scores for the different variables is given.

	Certainty	Trialability	Relative advantage	Observability	Compatibility	Complexity
CHWs at community level	+/-	+/-	+	+	+/-	+
sensitization by CHWs	+	+/-	+	+	+/-	+/-
IEC	+	+	+/-	+/-	+	+/-
giving materials	+/-	+	+	+	+	+
government strategies	+	+	+	+	+/-	+/-

Table 10: The strategy's attributes for different strategies. + means the strategy scores high on that attribute, +/- means it scores averagely and – means a low score.

Of most strategies there is low uncertainty, effects seem to be known. Only for the strategies 'giving materials' and 'CHWs doing community work', the effects were not known by all health centers. Respondents indicated that having a trial was for the CHWs-related strategies not always possible. This might be explained by the government enforcement, which may decrease possibilities for trials. For amenities and IEC, more easily some testing was possible. The relative advantage and observability is for all strategies high, only IEC is an exception to this.

Compatiblity and complexity are subdivided in the different questions that contributed to each of the attributes (Figure 11). The involvement of CHWs is preferred by the patients. However, for the health centers there are some more challenges. Personnel are not univocally positive and also there are capacity problems. For IEC and amenities for patients, compatibility is not a problem. Regarding the complexity there are clearly some more problems. Although it is clear what has to be done, it is not always easy to implement and can result in extra procedures, resulting in high complexity. Despite this, strategies are still introduced.

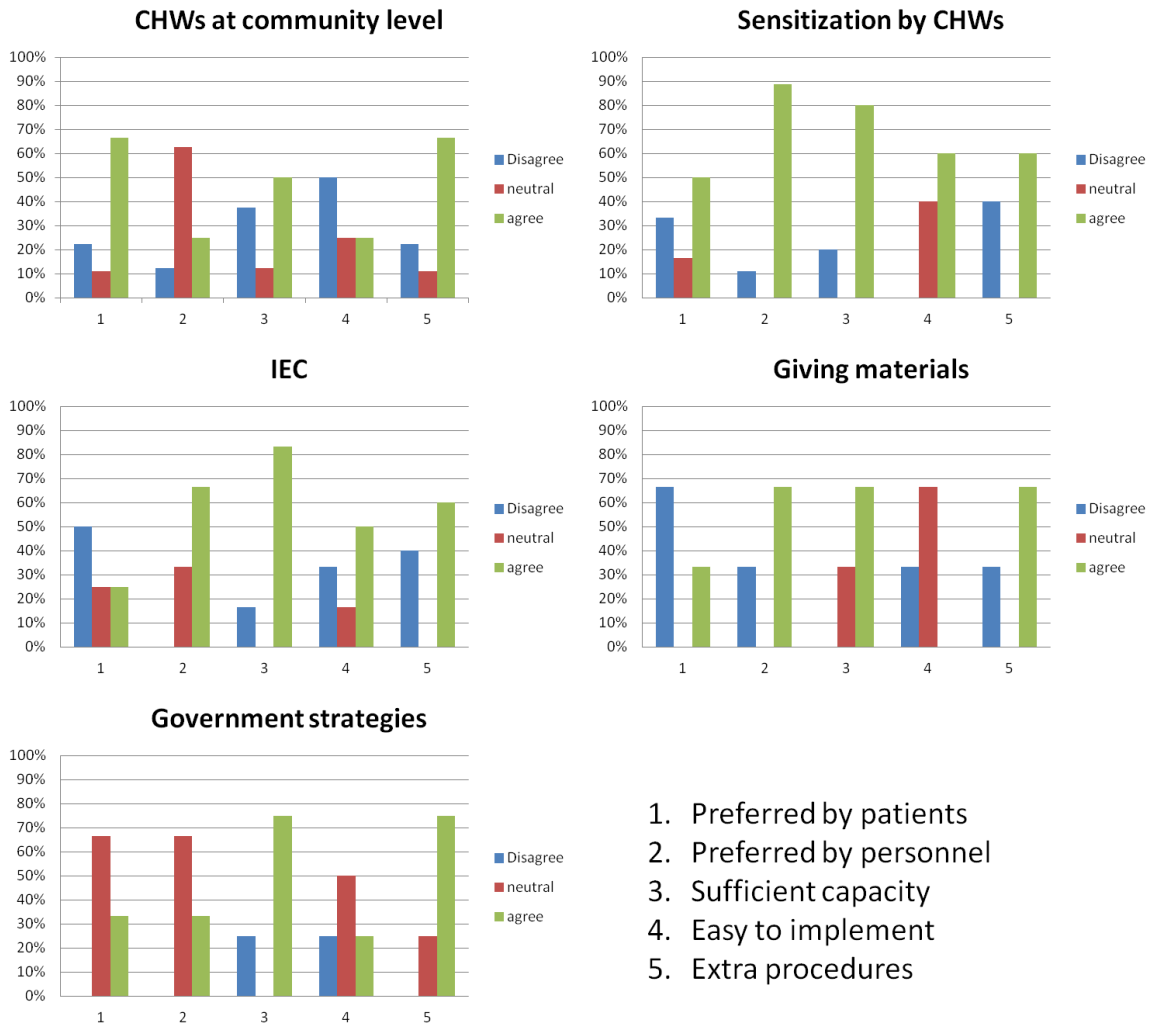

Figure 11: Characteristics regarding compatibility and complexity for the different strategies. Each plot represents a different strategy. For each strategy the scores on questions regarding the topics as numbered. Blue means the respondent disagrees, red is 'neutral' and green is 'agree'.

Health center characteristics

In Table 11 the relation between the strategies and the health center characteristics is shown. Because of the multiple questions for each characteristic, the statistical results are aggregated. For example, when 30% is displayed, this means that 30% of the questions that measure aspects of the characteristic show a statistical relation with the strategy.

The effect the structure of a health center has on different strategies is limited, only the sensitization by CHWs and the use of a schedule and timeline shows a relation with some of the measured elements of structure. The measured aspects of strategy have a statistical relation to several strategies, but only for a few indicators. Here the influence of indicators seems more important, where for 'structure' a possible relation depends more on the strategy.

For size there is no significant relation at all between different strategies and the measured items. This is similar for culture, except for 'house visits', there is a relation with some questions. This is again more depending on the strategy than on the question. For the characteristic 'resources', there is a relation between an indicator and the strategy in a few cases.

		Structure (%)	Strategy (%)	Size (%)	Resources (%)	Culture (%)
1.	**CHWs doing work at community level**	0	18	0	0	0
2.	**Extra post opened on other place**	0	9	0	7	0
3.	**Change opening times of posts**	0	9	0	7	0
4.	**Advanced field strategy**	0	0	0	0	0
5.	**Advanced strategy for vaccinations**	0	0	0	0	0
6.	**House visits**	0	18	0	7	20
7.	**Sensitization by CHWs**	38	9	0	7	0
8.	**IEC (information, education, communication)**	0	0	0	0	0
9.	**Involve local authorities**	0	9	0	7	0
10.	**Giving materials**	0	9	0	7	0
11.	**Schedule/timeline**	13	9	0	7	0
12.	**Training personnel**	0	0	0	0	0
13.	**Training CHWs**	0	18	0	0	0

Table 11: Influence of health center characteristics on the adoption of a strategy. Each of the five indicators consists of different questions. For all these questions significance is tested; displayed is the number of items that have in a $\chi 2$-test a value of $\alpha < 0.05$ (expressed as percentage).

When further analyzing the influence of the indicator strategy and its relation with the strategies, the priorities the health center has is most linked to different strategies (Table 12). A priority on vaccinations has a positive statistical relation with the involvement of CHWs, either doing work on the community level and by training them. For training of CHWs this relation is even stronger. Possibly the involvement of CHWs automatically leads to more attention for training them. Remarkable is the negative relation of CHW involvement and a focus on family planning, which is very strong. A focus on growth monitoring does have a correlation with 'opening an extra place' and 'schedule and timeline'. Both of these strategies are not frequently adopted (Table 3).

Of all the differences in resources in personnel, equipment and money, receiving money from a faith-based organization shows the only statistical relationship. Receiving funding from a faith-based organization shows a relation with sensitization by CHWs, involving local authorities and also the use of a schedule and timeline (Table 12).

For the faith-based organization the negative relationship is quite remarkable, but was explained in one of the interviews: "*There are large differences between faith-based organizations and public health centers. First the faith based health centers were performing good, because of clear rules and good infrastructure. However, it seems that PBF has had less effect on them, they were not trying to take initiatives like working in the weekend, family planning, etc*". Thus, the strength of faith-based health centers may for new strategies like PBF also be their weakness.

	Priorities of HC:							***Funding***
Strategy	*Curative*	*Deliveries*	*Vaccinations*	*Family planning*	*Antenatal care*	*Growth monitoring*	*STI*	*Faith-based*
CHWs doing work at community level	+	+	+*	−***	+	+	+	+
Extra post opened on other place	+	+	−	+	−	+*	−	+
Change opening times of posts	−	+	−	−	+*	−	−	−
House visits	+	+	+*	−	+	−	+**	−
Sensitization by CHWs	+	+	+	−*	−	−	−	−***
Involve local authorities	−*	+	−	+/-	+/-	−	−	−*
Schedule/timeline	−	−	−	−	+	+*	−	+**
Training CHWs	+	+*	+***	−	−	−	−	+

Table 12: The relation that has been found between a strategy and a focus of the health center. + means a focus has a positive effect on the presence of the strategy, - means that focus has a negative effect on the presence of the strategy (with a χ^2-test). * indicates $\alpha < 0.05$, ** indicates $\alpha < 0.01$, *** indicates $\alpha < 0.001$

Communication channels

How the supervisors have heard from different strategies varies (Figure 12). The most used communication channels are meetings and also the communication by government is important. Hearing it through informal channels such as personnel or other supervisors is not common. Several meetings have been identified, mainly on health center or district level; inter-district communication seems to be very limited and is not formalized. When looking at the importance of the different meetings, most important is the meeting between the different health centers, being led by either the hospital director or the coordinator of health at the district (Table 13).

The frequency of these meetings is in many cases monthly, but in some cases it is held weekly or quarterly (Table 13). Informal contact is on a more frequent basis, supervisors have weekly informal contact. However, the importance of this channel is indicated to be limited. How government communicates their strategies is unfortunately not studied.

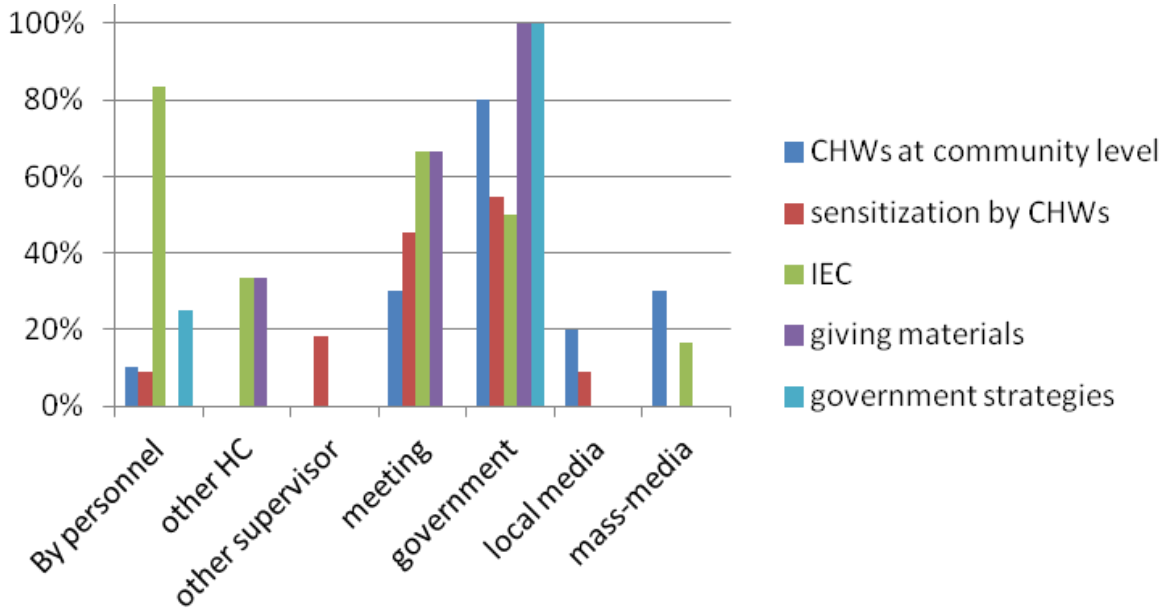

Figure 12: The communication channels that played a role in the diffusion for the different strategies. The respondents have answered the question about how they have heard from the strategy.

	Importance		Frequency		
	Most (%)	2nd most (%)	Weekly (%)	Monthly (%)	Quarterly (%)
Management committee of the HC	23	16	2	76	4
health committee	0	31	11	56	13
Health centers in districts	34	18	0	73	18
Supervisors within district	26	9	2	84	9
informal contacts between health centers	4	0	27	31	16
Informal contacts with supervisors	6	27	57	29	2
Other	8	0	-	--	-

Table 13: The importance and frequency of different meetings. The respondents have scored the different meetings in importance and frequency, with the % indicating the response rate for each answer.

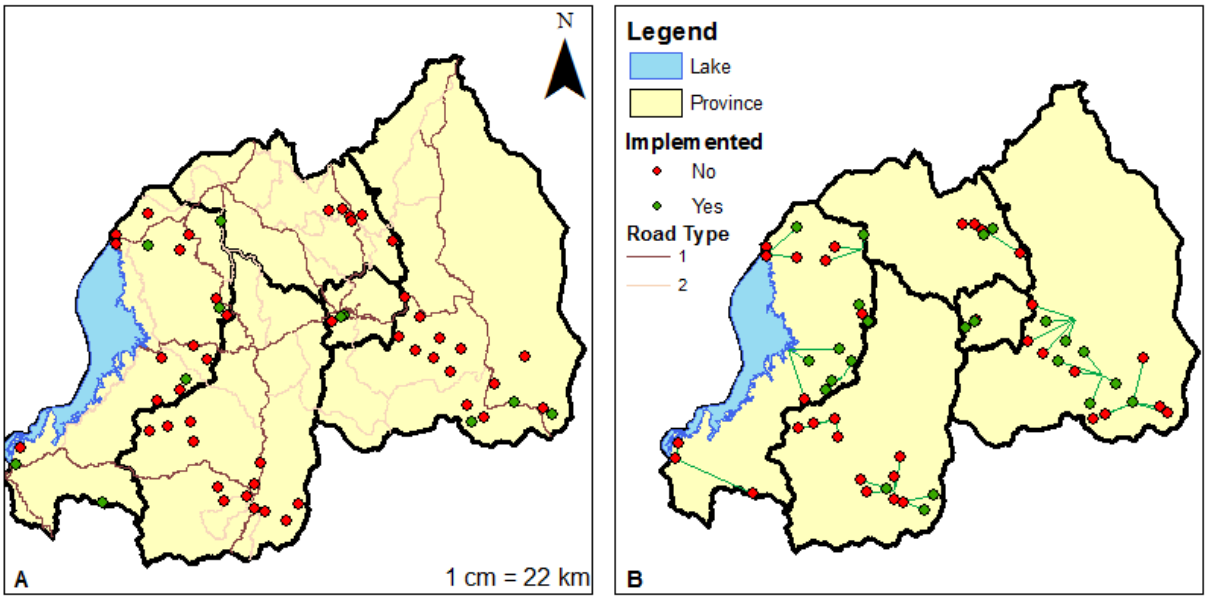

Figure 13: Implementation of strategies. In Figure A the adoption of the strategy 'Training of personnel' is shown with the underlying road network. In Figure B the distance to the supervising hospital is shown in combination with the strategy 'IEC'

Contextual factors

For identifying the influence of contextual factors two approaches were used. Visualization can be very useful to generate some ideas of possible factors that play a role. A good example is shown in Figure 13A, where the majority of the health centers who train personnel seem to be close to the main roads. This has led leads to analyzing the effect of the distance of health centers to the main road, but also the density of roads. Similar to that, for Figure 13B it could be hypothesized that the distance to the hospital or health centers might plays a role in the adoption of a strategy.

Secondary data on detailed level prove to be limitedly available. For most field research, results were aggregated back to district- or even to province level. Therefore, no further analysis was possible. However, the road network and the population in the sectors have been identified on detailed level.

The distance to the main road does have a statistical relation with the strategy of giving materials, just like using a schedule and timeline (Table 14). The distance to the parent hospital or the nearest health center does not have a relation with the adoption of any strategy. The population density of a sector shows for three strategies a statistical relation. The road density only plays a role for the change in opening times of the post. Whether this relation is positive or negative can with a χ^2-test not be determined, since there are multiple categories.

	Distance to:			**Density of:**	
	Main road	Hospital	Health center	Population	Roads
Change opening times of posts				+*	+**
Giving materials	+*				
Schedule/timeline	+*		+*		
Training personnel				+**	
Training CHWs				+**	

Table 14: The statistical relationships between strategies and contextual characteristics. + means a statistical relation with the presence of the strategy (with a χ^2-test), with * indicating $\alpha < 0.05$ and ** indicating $\alpha < 0.01$

For the influence of societal and political culture, there are two approaches. When important regional differences in culture would play a role, a clear difference between regions like provinces would be expected. However, as shown in Figure 14, for the adoption of strategies, no clear difference between provinces is seen.

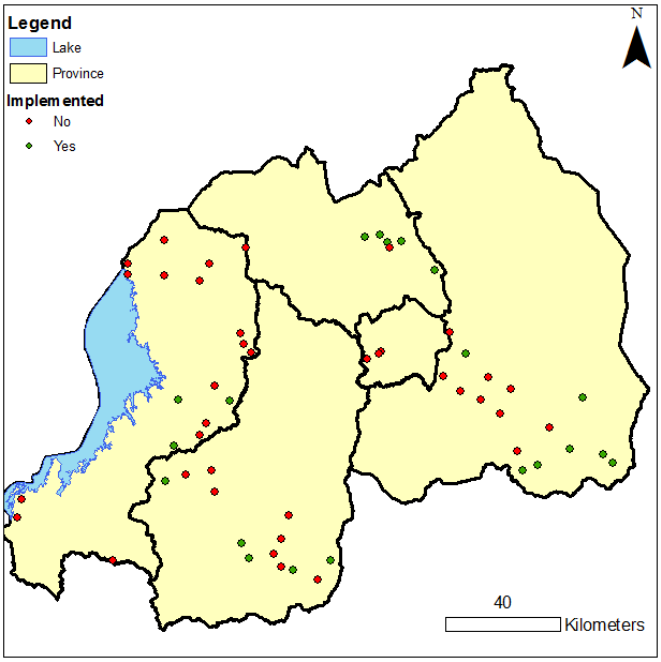

Figure 14: Presence of strategy 'giving materials' in the different provinces

In the questionnaire, there were also questions regarding the societal and political culture. What is indicated by respondents as most influential for what strategies a health center is using, is the Ministry of Health (Figure 15). This is in line with the observation that many of the seen strategies are government driven. Also can be seen that the role of the province is low, which is in line with the previous registration that there are no remarkable spatial differences. Other factors that have influence are the district, the district hospital and the health centers. This could partly explain the sometimes high prevalence of certain strategies within a cluster.

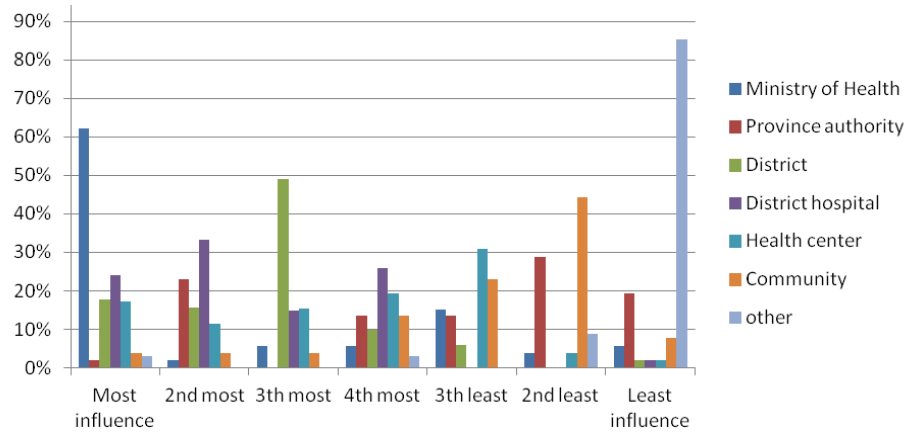

Figure 15: The influence of different actors on the health center policy. For each body is shown how they are scored on range of influence. E.g. by almost 50% of respondents the District is regarded to be the third-most influent body for health center policies.

4. Discussion

In the previous section the results of the analysis of this study are presented. In the current section these results are interpreted and their meaning is explained. In the first three subsections the relevance of the findings for the different objectives are extensively discussed. Later on, after assessing the internal and external validity of the study, some implications both international as for Rwanda remain. Then, this section is ended with the conclusions of this research and recommendations for further research.

4.1 Emergence of strategies

As was expected, the health centers do use different strategies to improve care. Some strategies are enforced through government, others are implemented on health centers own initiative. Most of the government strategies are present in many health centers, likely because of strong government enforcement and implementing well-considered strategies. Examples are, the community health workers (CHWs), who have an important role in improving access to health care and involving the community. The nation-wide implementation of these health workers is probably the most influential improvement of the last years. With the current introduction of PBF for these health workers, their importance may grow even further (Mugeni, et al., 2011).

For the health center strategies there are only few strategies that are listed by more than one or two health centers. Higher presence of strategies is probably related to its success. Thus, the frequent strategies are likely the successful strategies. Of these rather successful strategies an important component is the improvement of access. Health centers try to improve access to health care by going into the field themselves, e.g. advanced vaccination strategy, house visits and opening an extra post.

The majority of the described strategies are a likely result of PBF. In literature, e.g. Kalk et al., (2010) and Basinga et al., (2011), specific strategies of health centers to improve the health care have not yet been described. Strategies that have been described in literature are, among others, the community health insurance and free deliveries after four antenatal visits (Rusa, et al., 2009). However, these strategies are implemented independently from PBF.

The respondents have listed the strategies described in literature only very few times. The low frequency of these strategies being listed indicates that respondents were able to separate these strategies from PBF-related strategies. Thus, the strategies that have been observed and listed can with substantial certainty be considered as a result of PBF. This is in line with the observations of Meessen et al., (2007), that the establishment of a management committee has helped to boost performance by giving more space for initiative and involve staff.

Strategies to improve efficiency and technical performance of the health centers are frequently listed, with training and sharing schedules for vaccinations as most appealing. When looking at the high presence of having materials on stock and providing high-quality care, it is indicated that strategies not resulting in too much extra work are preferred.

The presence of strategies from health centers to improve access is quite low compared to the strategy of involving local authorities. For these access-improving strategies quite a lot of effort from health center personnel is needed (Witter, et al., 2012). This corresponds with the hypothesis that strategies that do not result in much extra work are preferred.

Objective 1: Get an overview of the different strategies that are, driven by PBF, introduced by health centers to improve their quality and increase the quantity of care they deliver.

In summary, where most government strategies are seen on improving access and involving community, mainly through CHWs, health centers also develop strategies on these areas, but are also triggered to improve on efficiency and technical performance. Likely, the incentives of PBF have largest influence on these areas. The incentives of PBF are not as such that health workers are very motivated to do much extra work. Governmental influence is high as these strategies show highest presence. This in line with other observations in which government is playing an important role in the health care system by showing political leadership, having accountability mechanisms and policy-making (Pose & Samuels, 2011).

4.2 Diffusion of strategies

Spatial diffusion

In line with the effort of the government regarding the CHWs, the CHWs are brought into action in every cluster. Other government strategies like 'giving materials' and the advanced vaccination strategy are less widely adopted and are not present in every cluster. For the latter strategies more responsibilities for the implementation are delegated to the district hospitals. This different implementation strategy may be an explanation for these differences in adoption.

Thus, presence of some of the government strategies may depend on the particular district hospital. This corresponds with the observation that high presence of government strategies is in most cases (except for cluster 3 and 5) accompanied by high presence of non-government strategies. For these clusters, the district hospital is likely to have a role in adoption by health centers. Therefore, it can be concluded that hierarchical diffusion within clusters is present even though depending on the cluster.

Sharing of strategies between health centers occurs (with or without district involvement), which is confirmed by the diffusion of two small non-government strategies, 'schedule/timeline' and 'opening an extra post'. Although these are restricted to only a few clusters, in two of these clusters, the presence is disproportionately high (cluster 1 and 6). This indicates that sharing within a cluster takes place at least in some clusters. However, this does depend on the strategy; some strategies are not shared within the cluster, with the strategy 'house visits' as the clearest example.

The nation-wide diffusion of strategies also contains elements of hierarchy and contagion. In the strategy 'involving local authorities' there is clearly some contagious diffusion, for 'using schedule and timeline' this is less visible. What can be seen though, is the spread over the country. More than half of the strategies are present in all circles, indicating good nation-wide diffusion. However, the presence of these strategies in the circles is not close to a 100%. This indicates that either the adoption depends on other factors like health center characteristics, or that contagious spread is slow.

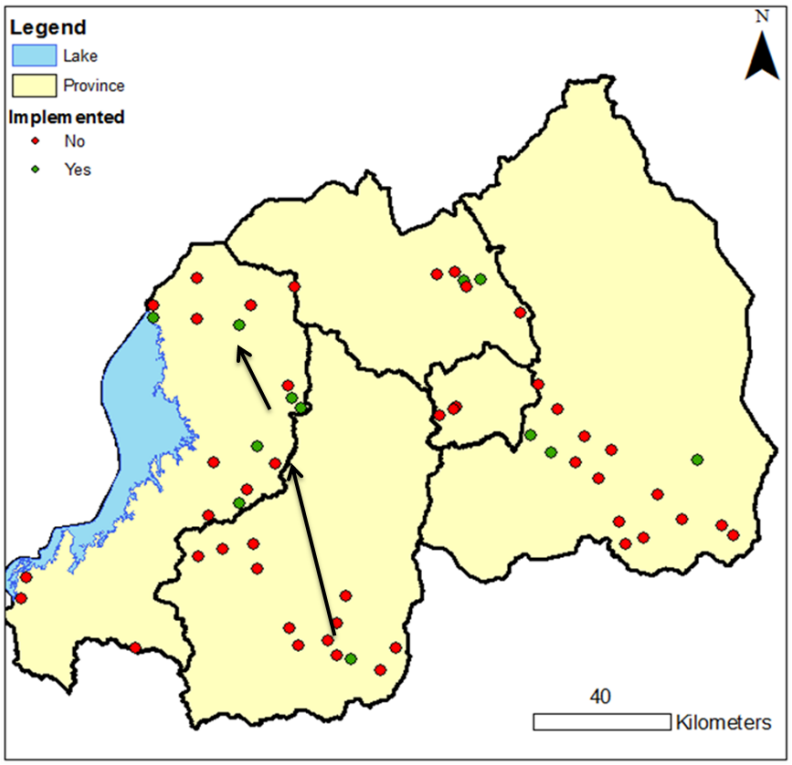

Figure 16: Tracking diffusion of 'advanced field strategy'. Origin of the strategy is in the south of the country. From there it has reached regions which are located more centrally. These have served as an example for health centers in the North.

When tracking the diffusion for one of the strategies ('advanced field strategy') by using the interviews, a similar combination of hierarchy and contagion can be seen (Figure 16). When following the diffusion pattern, it can be seen that the roots of the strategy are in the south. From there it has diffused quite some distance to the central-west of Rwanda. From there the strategy has spread further to the north and east. Although contagious diffusion can be seen, the hierarchical spread seems to be more important; it can be seen to spread quickly over the country.

Another observation that underlines the pattern of hierarchical diffusion is that for circle 4 and 5, the circles with a many different non-government strategies implemented, all the hospitals are located in large towns (Byumba, Gisenyi, Kibuye, Kigali and Rwamagana). This indicates that via the hospitals strategies spreads to the health centers.

Temporal diffusion

In this study it was expected that in PBF 0 the strategies would have highest adoption rates. For most strategies this was however not the case. A probable reason for this is the limited comprehensiveness with the national model. Nevertheless, there are some strategies that do meet this expectation, with 'house visits' as most apparent example.

For the presence of strategies in areas with a different moment of PBF introduction (PBF-phases), the presence of most strategies is highest in PBF 1 health centers. A possible explanation is that the PBF 0 areas all had a different kind of PBF system implemented, other than the finally nation-wide implemented PBF system. That PBF 2 has not (yet) reached the level of PBF 1 might be because PBF 2 is still running behind due to the (2-year) later implementation of PBF in those regions.

That PBF 2 is running behind is confirmed when assessing presence within the circles. Especially for most government strategies, presence is higher in PBF 1 clusters, also when compared to close-located PBF 2 clusters. For non-government strategies like 'advanced field strategy' there is not a clear diffusion pattern from PBF 1 to 2 or the contrary. This gives reason to assume that for the non-government strategies, of which most are probably more recent, there is a more equal distribution over the different PBF phase areas. Therefore, it is likely that health centers in the PBF2 regions will catch up. Also, it was indicated by one interviewee: "*When rolling the strategy out on national level, there was an intervention (PBF1) and control (PBF2) group. Already then, some strategies developed in the intervention group were adopted by the control group.*"

Appraisal of methods

As the presence of strategies is not always known, drawing conclusions should be done carefully. On top of that, the approach for studying the hierarchal, contagious and temporal diffusion is not beyond all doubts. This approach was chosen because of the good applicability, but it has not been studied whether the diffusion between PBF phases really represents temporal diffusion.

For the interpretation of the results on cluster level some questions were raised regarding hierarchal diffusion. The essence of hierarchical diffusion is that an entity high in hierarchy influences those lower in hierarchy. In this case that would respectively be the hospital and the health centers. However, the goal of hospitals differs from that of health centers, making translation from hospital strategies into health center strategies impossible. Thus, when looking on cluster level, there is no hierarchical diffusion in its original concept. However, there is an influence of the cluster on the presence of strategies, very likely influenced by the hospital. For that reason, it can be defended that also in this case hierarchy plays a role in the diffusion.

For the temporal and spatial diffusion, most debatable is the use of the circles (Figure 10). Although these circles were used for the sampling method, they also have an important role in the further analysis. Disadvantages are that the circles are overlapping, not entirely covering the country and differing in how many health centers they enclose. Still, because of the good balance of studying most of the country and paying attention to local properties, this method is preferred above others.

Objective 2: To describe the diffusion of different strategies over the country of Rwanda

The cluster in which a health center is located in plays an important role for the adoption of strategies, both for governmental and non-governmental strategies. This is in line with the observation that most important for diffusion over the country is the hierarchical diffusion. This results in a quick spread over the country. Contagious diffusion does also play a role but is slow. The nation-wide introduction of PBF has had a positive effect on the emergence and adoption of strategies, with the highest presence in regions where PBF has been introduced by government earliest. Now it remains to be seen whether the areas where PBF has been introduced later will catch by.

4.3 Factors to influence the adoption of strategies

Attributes of the strategy

The strategy's attributes are only known for a few strategies, which are all government strategies. For these different strategies some similarities regarding their attributes can be seen. All measured attributes except complexity are favorable or neutral for the strategies. This suggests that a basic level of certainty, trialability, observability, compatibility and relative advantage is needed before a strategy becomes enforced by government. This is in line with the evidence-based approach the government has in its policy-making (Pose & Samuels, 2011). The strong government enforcement may explain that also complex strategies are still introduced.

The government enforcement seems to be stronger for the community health workers than for IEC and giving materials. This is indicated by the lower compatibility of these strategies. The limited opportunities for having trials with CHWs fit with this statement as well. Cause of the higher enforcement may be the high priority the government is giving to the CHWs (Mugeni, et al., 2011).

Health center characteristics

The influence of the different health center characteristics on adoption has been demonstrated limitedly. Having priorities on various care aspects and being funded by a faith-based organization shows a positive relation with the adoption of schedule and timeline. But there is a negative relation with the sensitization by CHWs and the involvement of local authorities. As discussed previously, this may be the result of less flexibility.

The recent focus of the government on vaccinations seem to have had a positive effect on the use of CHWs. For that reason, it could be recommended for health centers to adapt a certain focus as well. This might lead to a more diverse presence of strategies within the health centers. More specific, more focus on growth monitoring may result in spread of a few small strategies like opening an extra post or using a schedule and timeline.

The fact that the other characteristics show only such a limited relation with the strategies is remarkable and is not in line with what is described in literature (Wejnert, 2002). An explanation can be that the health center is not the correct unit of adoption (Anderson, et al., 2004). In that case more questions should have been about the head of the health center or the supervisors. Another likely possibility is that the health centers are in general already quite homogenous and that differences measured are marginal. This is in line with the answers of the questionnaire, which are all not very dispersed (see Appendix VII).

Communication channels

Health centers are informed by and communicate through meetings. Furthermore, government communication is important. Inter-district meetings are not formally established and have not been shown to take place. Only the district coordinators have meetings and use informal channels like mailing. A nice small initiative was started by a coordinator on district level to increase sharing within the district: "*There is a meeting every three months in which the outperforming departments of health centers have to present how they are achieving this high performance*". Although currently in testing phase, it seems to be a promising strategy to enhance sharing through meetings.

Regarding contextual factors, there is only limited relation with the different variables, which is similar to the health center characteristics. A reason for this may be the failing collection of secondary data. Most data was only present on province level. Since there is no evident clustering, influence of factors like employment, transport possibilities, presence of diseases like HIV, could not be investigated.

Contextual variables

Of the contextual variables that were known on detailed level, only population density and the distance to main roads are affecting the adoption of certain strategies. Where in Rwanda population density is quite homogeneous, for other countries this effect could be more important. The observed high influence of the ministry of health and the district hospital on the policies of the health centers are in line with the previous observations.

It appears that only some of the many characteristics that have been identified to influence diffusion have a clear influence in this case. This is therefore not in line with literature (Rogers, 1995a; Wejnert, 2002). Perhaps it would be useful to slightly adapt the framework from diffusion to dissemination, which pays more attention to societal sectors, the nature of the diffusion system and organizational implementation and adaptation (Dearing, 2008).

Appraisal of methods

For the analysis of the influence of health center and contextual characteristics on the different strategies a χ^2-test was used. This method was chosen since both strategies and characteristics have binary outcomes. For the contextual characteristics conclusions should be drawn cautiously, since the binning of population and distances does affect the results.

There was chosen for $\alpha < 0.05$ as boundary to be statistical, despite the many χ^2-tests used. In this way, an indication for relations is given and also gives good insight in trends, like the influence of a focus on vaccinations on strategies regarding CHWs. With the further analysis of some variables, more certain relations are shown with stricter α-values.

For the contextual factors the advantage of spatial mapping is largest. Grouping, the effect of external factors like roads or sector-specific properties can easily be visualized and interpreted. However, to compress this to make it fit in a report is more difficult. For that reason only some examples are shown in which interesting results are apparent.

Objective 3: To determine the characteristics that influence the adoption of strategies in the health centers.

Concluding, there is a very limited influence of external factors on the adoption of strategies. For health center characteristics and contextual factors, only the focus of health centers, a relation with faith-based organizations and population density do show an influence on the adoption of strategies. For communication the government is very important but also the meetings between the health centers of a cluster.

4.4 Validity

Based on the previous subsections some conclusions have been drawn. To translate these to implications for different actors in Rwanda, the internal validity of this research is assessed. With that in consideration, the conclusions that are still standing are translated to implications for actors in Rwanda. Also the external validity of this study is assessed. This helps in defining implications for other countries who are interested in PBF, but also what PBF means for reaching the MDGs.

Internal validity

For the survey a response rate of 77% has been achieved. The non-responding health centers are evenly distributed over the country. Only for two clusters in the north, high non-responding rates were found. This is mainly caused by the size of the cluster, being so large that many health centers were included. There were not always sufficient staff members present to answer the questionnaires. Questionnaires were distributed randomly, leaving only a small chance that distortion is caused. However, extrapolating the results within the clusters should be done more careful.

Some possible confounding variables are the function of the respondent and session variations like time needed to answer, deliberation and asking for clarification. These show some influence on the presence of a few different strategies. However, with a slightly different interpretation, these differences between sessions could also be considered as hospital or supervisor characteristics. These differences between clusters and how they influence the adoption of strategies, is also a valuable observation for further research.

Since the questionnaire has only been pre-tested and not further validated, there are some questions regarding its validity and reliability. However, the presentation given in advance and the presence of someone to clarify questions if demanded have contributed in overcoming this problem. The presentation was standardized and the person present to answer any questions was always the same. However, some differences may have occurred. The fact that there is no clear clustering in the respondents' answers indicates the influence to be limited and thus answers are quite valid and reliable.

Validity of analysis

The analysis techniques used in this research are limited. For objective 1 the different strategies were scored on their relation with PBF and being a strategy. This has been assessed by only a single person, and is thus not prevented from possible differences in interpretation. However, all strategies are listed, allowing others to assess whether scoring has been done correctly.

Regarding the spatial analysis of the data, the main challenge has been to keep clarity. Therefore, data is presented for groups of health centers. This may either be clusters, PBF-phases or sampling circles. Consequently, data had to be merged and averaged. This may have resulted in some, inevitable, distortion of the data. With more specialized spatial analysis techniques distortion may be prevented. However, with the current analysis is achieved to do justice to both nationwide as local variations.

For analysis of the different components to influence the diffusion there was chosen to use χ^2-tests. This test is often used to assess whether there is a relationship between two variables which are nominal or ordinal (Babbie, 2010). Other frequently used methods like t-test and regression analysis use assumptions this research does not meet. For these tests interval data is needed. Since the (nominal) answers of the questionnaire are used as input, the χ^2-test is most appropriate (Babbie, 2010). In further research, it could be possible to aggregate the answers to different questions. This would enable other analysis techniques. However, aggregation should be done carefully and data is often not suitable for statistical analysis.

For the strategies' attributes there was chosen for aggregation. However, statistical testing was not possible because of limited reliability. This is not a problem; statistical testing would not have been useful because there were a limited number of answers per strategy. With the aggregation a quick overview is given of the situation, enabling it for interpretation.

External validity

Essential for external validity is a high internal validity. When the results of the research are not reliable, they can also not be translated to other countries. The internal validity does have some problems, but the responses to the questionnaires suggest these problems to be limited. Presentation of data is done without too much analysis. Although there may be some distortion, overall the results are not very sensitive for distortion. Thus, extrapolation of the results of this research is justified.

Health centers from all over the country have been included in this study. This, random selection and stratification for the different PBF phases contribute to a fairly high external validity. Also the random inclusion of health centers in either in towns and in rural areas contributes to this.

PBF is not only applied in Rwanda, but is also gaining popularity in neighboring countries and in developing countries worldwide. This raises questions about the transferability of the results of this research. Rwanda is characterized as a small, densely populated country with a strong government. As has been shown in the study, population density of a region has influence on some of the strategies. Also the government has a large role in all frequently seen strategies. For that reason, extrapolation to other countries is difficult and should be done carefully.

4.5 Implications

For Rwanda

A recommendation for the Rwandan government is to continue their endeavor to improve the health care (Sekabaraga, et al., 2011). This should be done both by leaving liberty to health centers, as by adopting and enforcing successful strategies. Mechanisms to share strategies are present, but sharing could be enhanced. Between clusters hardly any channels for communication are present. Therefore, to implement a formalized meeting between health centers and district hospitals from different regions would be recommended. Also within a district improvement is possible. A useful suggestion to improve this, as given by one of the interviewees, is a meeting in which health centers are asked to present the points where they excel in could be very useful.

Urging the health centers to prioritize helps them in developing strategies. This is not yet done by all health centers. Where a focus on vaccinations will mainly help for the involvement of CHWs, focus on growth monitoring will stimulate more recent strategies. Also, when new strategies emerge, assessing them on certainty, trialability, observability, compatibility and relative advantage is recommended to ease the partition for probable successful and unsuccessful strategies.

What can be seen is that currently most new strategies seem to emerge in the regions where PBF has been implemented later. This suggests some decrease of innovativeness in regions where PBF is already present for a long time. Therefore, it is recommended to include in PBF some extra indicators to measure the degree of innovativeness. This also prevents PBF to become normal: *"employees were complaining that they could not give PBF as part of their loan, thereby increasing their mortgage"* or to become a punishing tool: *PBF has become a tool of punishment instead of a tool for reward, since there is mostly threatened to cut or reduce PBF".* Also when strategies in other categories are desired, e.g. the responsiveness to patient preferences, PBF indicators should be adjusted.

For other countries

As discussed previously, PBF is a very broad concept which can be implemented in many different ways (Witter, et al., 2012). However, in the endeavor of reaching the MDGs and improve health in different areas PBF may have an important role (Bosch-Capblanch, Kelly, & Garner, 2011; Sambo, et al., 2011). Therefore, even though not directly applicable in the new situation, some strong elements of the Rwandan health care and PBF system are discussed.

Essential in Rwanda is the influence of the government. One aspect is the comprehensive approach for health care (Sekabaraga, et al., 2011), but also their drive to enforce successful strategies is important. However, the creation of new strategies has to come from the health centers, thus there should be room for innovation by the health centers. These aspects, power to health centers and a strong government both seem essential for the arising and diffusion of the strategies to increase care.

The nation-wide implementation has shown a positive effect on the strategies, leading to more strategies. There is no clear indication for any positive effects of phase-wise implementation. However, also no negative effects are indicated, leaving it to the choice of the government what is most convenient for introduction.

Another point is the limited role of health center characteristics. There are no clear characteristics which impede the adoption of strategies. This could suggest two things. First, it could suggest that also in other countries this will not be important. Second, it could mean that the health centers are essentially quite homogeneous, differences are only marginal. This makes a strategy which is suitable for one health center, also suitable for other health centers. This is more likely, given the many common characteristics of the health centers (Pose & Samuels, 2011). This could thus be a condition for other countries, or at least something to keep in mind. For that reason this study is more difficult to extrapolate.

Millennium development goals

PBF has been introduced as a mean to overcome supply barriers of the health care system and in this way contribute to the striven of reaching the MDGs (Sekabaraga, et al., 2011). Since the deadline for the MDGs is approaching, quick results are necessary. But of course not only quick results are needed; the essence of the MDGs is that also after the deadline the achieved results remain existent. As has been shown by Basinga et al., (2011) within a short time span there are already improvements visible, thus quick results are obtained. This research shows that also effects on the long term are present and thus the results are likely to remain existent. In conclusion, PBF can contribute to reach the MDGs to reduce child mortality and improve maternal health.

4.6 Strengths and limitations of this study

The choice to target the questionnaire to supervisors of health centers has both benefits and drawbacks. The supervisors do have a good overview of different health centers, they are easy to approach and they have no direct connection to the health centers. Downside is that a supervisor doesn't know all the specific details of the health center.

Similarly, the presentation given in advance to handing over the questionnaire has some positive and negative effects. The presentation gives the respondents more understanding of the research, but can also lead to some expectation bias. Given the fact that many different strategies are listed indicates that the presentation has not lead to bias for strategies.

The fact that the respondents could deliberate during the answering the questionnaire, possibly has brought answers within a cluster closer together. However, with the mapping of the different characteristics and strategies, no clear grouping in the clusters is visible, reducing the possibility of bias.

This study has tried to make an inventory of all the strategies present. For that reason, open questions have been used. This has as undesired effect that when for a health center a strategy is not listed, it is not certain it is not present. For example, government strategies are clearly not always listed. However, it does not necessarily mean that it has not been implemented. Government strategies would be expected to be used almost everywhere (as the government has enforced it). On the other hand, the fact that it has not been mentioned could indicate that the implementation is limited or minimal, still making it useful to study the diffusion. Because of this uncertainty, interpretation should be done with caution, e.g. by only accepting large differences as being a difference.

The high response rates, the inclusion of health centers all over the country and the extensive incorporation of factors to influence adoption and diffusion are all strong points of this study. However, there is one aspect that makes this study unique in its kind. The comprehensive approach of studying the diffusion pattern and the characteristics influencing the diffusion has only been done limitedly (Pedersen, 1970); combining the spatial approach with the sociological approach is unique. To study the diffusion of the strategies, a spatial approach can hardly be done without. Although hierarchy and the PBF phases could be measured without using any spatial analysis, it does ease the analysis. A next step in this is to create more internal links between the diffusion research and the underlying characteristics influencing this.

The real added value of using spatial tools is in analyzing the influence of contextual characteristics. Where underlying connections are difficult to see, spatial analysis has the power to easily visualize these connections. A good example is the assessment of the influence of the main roads. Also other measured characteristics can be visualized, indicating some underlying processes, probably related to the context. In this study clustering of the measured characteristics was very limited, perhaps because of the small area of Rwanda. However, it is strongly recommended to include it in analysis in other studies.

4.7 Conclusion

There clearly is entrepreneurship by the health centers, leading to new strategies to improve care, contributing to the improvement of care by PBF. Strategies are mainly seen for improvement of access, community involvement, efficiency and technical performance. These can be new strategies, but also changed government strategies adapted to the local situation, with the advanced field strategy as the best example. Both hierarchical and contagious diffusion of strategies between health centers is present but is slow, particularly the contagious diffusion.

Because of the slow diffusion, for nation-wide implementation of strategies the government has an important role. There is indication that the government enforces strategies in two ways. The implementation of CHWs has been quite strict, where for other government strategies, the decentralized system of Rwanda is used. Although this is less effective in overall implementation, with a good choice of strategies that satisfy certainty, trialability compatibility, observability and show a relative advantage, also nation-wide implementation is achieved.

Besides the government, also district organizations, both hospitals and administrative bodies, have an important role in the adoption of strategies, as indicated by the large relative difference between districts. This is underlined by the importance that the respondents have attached to the communication between health centers and supervisors in the districts. Influence of the health center or other contextual characteristics is limited to focus of health center, funding from a faith-based organization and population density.

In other research PBF has shown to contribute to the MDGs in the short term (Montagu & Yamey, 2011). The slow diffusion of the strategies indicates entrepreneurialism not to be the core working mechanism of PBF. However, the effects of this entrepreneurialism are likely to contribute to more substantial effects of PBF. With that, also in the long run PBF will probably contribute to reaching the MDGs. This makes financing on performance a serious option for financing health in low-income countries.

4.8 Further research

The first recommendation is to analyze the data in this study in more depth. A large gain can be achieved by hybridizing both diffusion research and the underlying characteristics. Where now only small influence of health center characteristics were seen, linking it with local diffusion could give more insight. A practical way to do this has, however, not yet been described in literature.

Because of the extensive data-set collected, all data is presented quite superficially. More in-depth analysis would be recommended. For the diffusion, more spatial analysis tools could be used to study both hierarchical and contagious diffusion. There can be thought of analysis on distance of health centers with similar strategies, but also the influence of how high a health center is in hierarchy compared to others. For the influencing key factors, there could be searched for more coherence between different factors, but also spatial analysis for contextual characteristics could be performed.

There are various areas on which research with new data collection is recommended. Since the character of this study has been quite exploratory, there are some elements which could be studied more in depth. As has been seen, the government has a large role in different strategies. How this government acts exactly and how the communication channels of the government are functioning. This could give insight in how to improve or function as example for other countries.

A real challenge is the symbiosis of the contextual factors with the geographical distribution. With health- and demographic surveys, it is recommended to collect the data on sector level. With this, possibilities for spatial analysis increase substantially. Hence, more knowledge on the spatial diffusion can be gathered.

Now that an extensive overview of the current strategies is presented in this research, a more extensive study of the presence of various strategies in all health centers can be done. The diffusion pattern can be traced back for strategies and causality can be investigated.

To get even better insight in causality, a prospective study is recommended. When introduced in a new country, monitoring changes in health centers from the beginning could be very valuable. Prospective study enables continuously following of diffusion both spatial and temporal.

For the extrapolation of the results similar research in other countries is recommended. In that way the effect of different circumstances can be identified. Factors that might play a role are government, culture differences and a different health care system. With these studies, for other countries it can be predicted how PBF will work out in a more reliable way.

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6. Epilogue

The here presented study started with a simple email about a health sciences research in a developing countries in the form of a MSc thesis. This should be the first step in a possible collaboration between the ITC and the department of HTSR. On this I responded enthusiastically, which resulted in me being in Rwanda eight months later. With my assignment possibilities were explored to enhance further intra-university collaboration between the faculties of ITC and management & government. Because of this I would like to describe the process of this project, to ease further MSc projects within this collaboration.

The first step was to choose a topic for study. Luckily a topic was suggested by a future PhD student from Rwanda. After further refinement and modify it such that it was suitable for a master research in health science, the topic was there. It has shown to be really important to define a question that is locally relevant, since without local support it is hardly possible to accomplish a research like this.

Then I had to take some steps in developing geographic skills which are certainly needed when collaborating with ITC. To develop these skills some self-study was used. Although assignments are quite easy to execute, the way of thinking prove to be more of a challenge. For that reason, I would highly recommend some classes in GIS and spatial analysis.

After further preparations, e.g. writing a research report, I flew in September to Rwanda to perform the research. I was very glad with my arrival there. There was someone to pick me from the airport; there was a place to stay and someone to show me around. These things are in my opinion necessary for a good start; from there you can do most things yourself.

The combination of geography and health sciences proved to be very challenging. I was really lacking some basic knowledge in the field of geography. In every contact moment with ITC there were many things to improve. It felt like I would never be able to acquire the needed skills. Combined with the pressure on results, this sometimes led to frustrations. However, I really enjoyed acquiring knowledge on this area and it was a great added value to the project.

I also really appreciated the frequent contact moments with my supervisors, mostly held via Skype. Although not as ideal as face-to-face meetings the sessions were useful for discussing progress and plans. In my experience deliberation during the phone meetings fell a bit short, making implementation of all the discussed topics a bit more difficult.

In Rwanda, the next challenge was to figure out how to get approval to perform my research. With no supervisor on location, it was really up to me to find this out. After an ethical and methodological approval at the School of Public Health the Minister of Health was asked for authorization. After the necessary waiting and keeping pressure, just before Christmas the authorization was finally there. This meant more delay than I actually participated on.

Data collection was particularly a logistic puzzle, with visiting 14 hospitals in an equal number of days. Both for informing hospital directors and the visiting of the hospitals it turned out to be indispensible to do this without a local assistant. Once I arrived at the hospitals I was positively surprised with the collaboration of the employees. Thus, although permission from the ministry is needed, once granted it is a great help for the data collection and very important for a good research.

The delay in the data collection and the high response rate led to also more delay in the data analysis. I really had problems with performing a proper and thorough analysis of all the data. There was a lot possible, but due to time constraints I could not analyze as much as was actually desired. Especially, in the symbiosis of the parts of geography and the influencing characteristics I think large improvement can still be made which could increase the added value. Because of my limited time available I was not able to figure out how to do this best.

After all I think I can say it has been worth the effort. The assignment was challenging but good to do. The experience itself was amazing and very valuable. Building a new life in a foreign country is really good for learning how to deal with yourself and with others. Being at the intersection of two very different disciplines has always been my interest, it was actually one of the reasons I chose to study Technical Medicine. Thus, I'm very grateful that I've been given the opportunity to undertake this and I really would recommend others just to do it.

7. Appendices

Appendix I: Questionnaire

Appendix II: Questionnaire Rationale

Appendix III: Interview

Appendix IV: Sampling strategy Rationale

Appendix V: Theoretical framework

Appendix VI: Extensive results spatially

Appendix VII: Extensive results influencing factors

Appendix VIII: Results interview categorized on topic