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Application of Embedded Implementation Science to Developing Community-based Primary Health Care in Ghana

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Abstract

Successful experiments for developing community-based health services often end without contributing to reform of large-scale programme implementation. In Ghana, however, the national implementation of community-based primary health care services, policy formation and action have been grounded in a continuous process of evidence-based planning. Originally launched as a three-village pilot project located in a single rural district, community-based health care in Ghana currently reaches over 3,000 communities dispersed in all 212 districts. This successful expansion of evidence-based health care has been the outcome of embedding science into the management systems. Beginning with diagnostic systems research and followed by phases for experimentation, replication, and scaling-up, the implementation of community-based primary health care has been guided by science that aims to improve the pace of programme expansion, the quality and intensity of community-based care, and reform of national operations when problems arose. In this process, embedding implementation science into routine national programming has sustained research utilization, clarified milestones, and accelerated the pace of scaling up progress. By providing insights into practical actions that can improve functioning, results from embedded research function as a component of programme management rather than something that researchers are challenged to hand over to policy makers and managers.

Key words: Ghana; scaling up; community-based; primary health care; embedded science; implementation research; research utilization.

INTRODUCTION

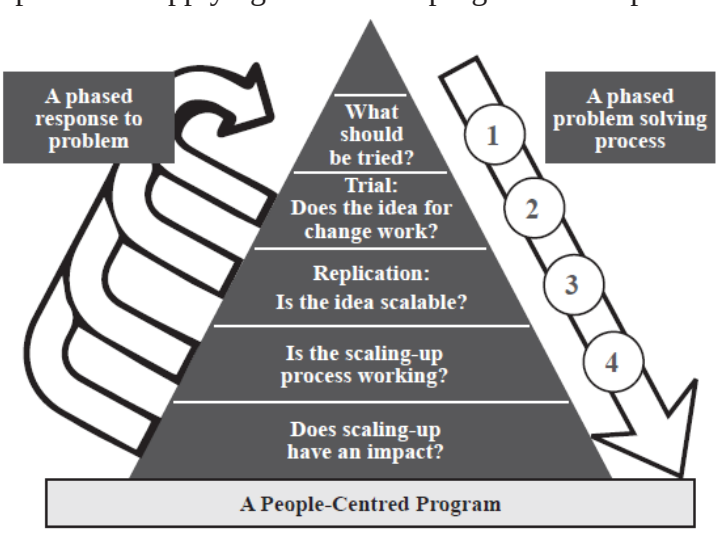
Community-based primary health care in Ghana has expanded from a three-village pilot project located in a single district in 1996 (Binka, *et al.*, 1995) to services that now reach over half of Ghana's 8,000 communities. This expansion of care has been informed by a continuous process of investigation and evidence-based programming that has been grounded in evidence that emerged from a trial of ways to improve the accessibility of community based care (Binka, *et al.*, 2007; Phillips, *et al.*, 2006). Contrasting with the common practice of concluding research episodes with appeals to put results to use, the Ghana model involves sequential phases in systems development that integrate research activities into the policy and programmatic development process. This model was adapted from successful strategies for scaling up health service innovations in Bangladesh (Cleland, *et al.*, 1994; Phillips *et al.*, 1988; Phillips, *et al.*, 1984) and informed by strategies and frameworks developed by a task force of WHO that focused on the science of scaling up (Simmons, *et al.* 2007; Fajans, *et al.* 2006). By embedding research into programme planning, implementation, and leadership processes, the Ghana approach has ensured that research results are utilized for management, obviating the need for deliberations on how best to put results to use. Moreover, embedded participatory research has ensured that mechanisms of social organization, traditional governance, and social networks could be marshaled for sustaining organizational improvement over time (Emery 2000; Katz & Kahn, 1978). The Ghana institutional grounding for research represents a successful, sustainable, and scalable strategy for achieving people-centered programming that applies principles of participatory management of research that have shown elsewhere to foster research utilization (Ghaffar, *et al.*, 2017), sustain innovation (Gruen, *et al.*, 2008; Palen *et al.*, 2012), foster capacity building (Goldberg & Bryant, 2012a) and catalyze research utilization and scale-up (Beaglehole, *et al.*, 2008).

THE METHOD

Several African countries have directed priority to developing community-based primary health care (Bhutta, *et al.* 2005 and 2008). A 1992 Ghana Ministry of Health (MOH) policy review summarized evidence that health services were failing to reach the rural poor (Ministry of Health of the Republic of Ghana, 1998). Policy questions that arose in response to this review fostered a four-phased progression of initiatives for developing community-based primary health care (Figure 1) (Olsen, 1998):

Phase 1: Configuring community-based services. It is common knowledge that social organizational structures profoundly influence daily life in rural Africa. Less is known, however, about practical means of utilizing these traditions for programmatic leadership, decision-making, and communication components of primary health care systems. To achieve strategic convergence of tradition with programme governance, an 18-month three village project was launched by the Navrongo Health Research Centre for eliciting community advice on primary health care and family planning service implementation. A team of scientists and administrators were embedded in a

Figure 1: The phased process of applying evidence to program development in Ghana



process of intensive community dialogue, strategic planning, and collaborative micro-implementation. This pilot clarified culturally compatible strategies for community health service leadership, supervision, and worker deployment (Nazzar, *et al.*, 1995; Nyonator, *et al.*, 2005). Qualitative research was used to develop a knowledge-base for guiding strategic planning, using conventional methods for inference (Carr, 2011).

Phase 2: A plausibility experiment. Questions concerning the relative merits of deploying volunteer versus professional community-based workers could not be resolved by the three-village pilot (Haines, *et al.*, 2007; Betts, 2003; Boone, *et al.*, 2016; Lehmann & Sanders, 2007; Tindana, *et al.*, 2011). A factorial experiment was convened in all 38 communities in the district where research operations of the Navrongo Centre were located. One arm of the project assigned nurses to community resident locations while another arm marshaled mechanisms of chieftaincy, social networks, village gatherings, and community support for volunteer worker deployment. Since strategic arms representing community nurse versus volunteer deployment could be implemented independently, jointly, or not at all, a four-celled experiment was implied by the outcome of Phase 1. Communities were assigned to each of the four contrasting service deployment strategies with research configured to gauge the demographic impact of each one. In order to accelerate project implementation, community engagement was initially focused on mobilizing volunteers to construct health posts using traditional construction methods, and community resources, permitting project operations to begin without incurring delay that could arise if action had required investment in construction.

Wherever nurses were deployed, rapid declines in childhood mortality were observed (Binka, *et al.*, 2007; Pence, *et al.*, 2007); wherever volunteers were added to their operation, fertility effects were also evident (Phillips, *et al.*, 2006). Thus, the joint nurse plus volunteer implementation cell of the project became the focus of national scale-up (Nyonator, *et al.*, 2005). Management of the programme and scientific direction of operations were conducted jointly, with arrangements to ensure that lessons learnt were immediately shared with a national project governing committee, thereby embedding the research operation into the national policy development system.

Phase 3: Replication research. Success of the Navrongo trial provided little guidance on how to scale-up operations within the large scale system. With no external revenue to support start-up construction costs, no district in Ghana could take forward all the implementation activities in a single step. Scaling up community-based care had to be financed with local resources and decentralized at the community level. Implementation required mechanisms for establishing community accountability, service quality, and administrative control of service operations (Awoonor-Williams, *et al.*, 2015b). Nkwanta provided a platform for clarifying how this process could work. Six essential sequential community-level implementation milestones were identified that could be implemented with local resources (Awoonor-Williams, *et al.*, 2004). Research showed that achieving these milestones replicated Navrongo results (Awoonor-Williams, *et al.*, 2010). Since Nkwanta was a realistic setting that lacked special resources, replication results enhanced the operational credibility of the Navrongo model (Awoonor-Williams, *et al.*, 2013). All activities of the Nkwanta trial were conducted jointly with the District Health Management Team. The Project Principal Investigator was also the District Director of Health Services. In 1999, the Navrongo model was adopted as the national policy due to a large measure of credibility for the model that emerged from the Nkwanta demonstration. In 2000 a programme known as Community-based Health Planning and Services (CHPS) was launched to coordinate scale-up.

Phase 4: Evidence-based scale-up. CHPS was implemented in "lead districts" in each of Ghana's 10 regions for disseminating the Nkwanta demonstration capability gained through demonstration and shared learning. But this catalytic process was particularly pronounced in 32 districts out of the total of 126 districts in the country.1 In this subset of districts managers and implementation teams had been granted opportunities for peer orientation in Nkwanta and Navrongo and provided with small grants to finance implementation in one or two communities (Nyonator, *et al.*, 2008). By embedding implementation teams into the ongoing research activities of Navrongo and Nkwanta, systems learning could be pursued through peer exchanges. Statistical models of milestone progression utilizing national monitoring data (Table 1) show that the District Health Management Teams (DHMTs) that had participated in the Nkwanta exchanges were more than twice as likely to implement the programme as were those that had not received any orientation (Nyonator, Awoonor-Williams, and Phillips, 2011).

Table 1 results are adjusted quarterly increments in population coverage in 32 districts participating in the "scaling down" embedded learning approach relative to the rate observed in 94 non-participating districts. Of the 32 participating districts, 8 had management teams that were oriented to CHPS in both Nkwanta and Navrongo. Regression adjusted time trends suggest that quarterly start-up rates of CHPS spread were accelerated by 0.3 percent if managers were embedded in Navrongo operations and 0.1 percent per quarter greater if teams were assigned to Nkwanta for orientation.2 Grants that financed start-up costs enabled teams to translate lessons from participatory learning into pilot activities in one or two demonstration communities. Demonstration communities served, in turn, as venues for exchanges with stakeholders from neighboring communities.

All 126 district teams received workshop based training, but where leadership training was embedded in a scaling up demonstration, initially it was accelerated by catalytic learning. Mean CHPS cumulative coverage rates and random effects regression quarterly show incremental effects of participatory exchanges over the CHPS programme initial start-up period: January 1, 2001 to July 31, 2004.

TABLE 1: MEAN CHPS CUMULATIVE COVERAGE RATES AND RANDOM EFFECTS REGRESSION QUARTERLY INCREMENTAL EFFECTS OF PARTICIPATORY EXCHANGES OVER THE CHPS PROGRAMME START-UP PERIOD: 1 JANUARY, 2001 TO 31 JULY, 2004.

Variables	**Percent of the population covered by CHPS …**		
	Community Health Officer deployment	***Volunteer deployment***	***Number of Districts:[a]***
Cumulative percent population covered by….	3.1	1.4	126
…districts where managers participated or did not participate in Navrongo demonstrations:			
Participating	9.1	4.7	17
Not participating	2.2	0..9	99
…districts where managers participated or did not participate in Nkwanta demonstrations:			
Participating	4.0	0.4	15
Not participating	2.6	1.4	111
Estimates of multiple regression random effects of the incremental quarterly change in percent of the population covered by CHPS associated with embedding learning in….[b]			
Navrongo	+0.3*	+0.3*	1764 district quarterly observations
Nkwanta	+0.1*	-0.0	

Where teams could make this process function, there was generation of a contagion of implementation capabilities. In some districts, this social contagion was augmented by grassroots political processes. Throughout Ghana, the national development revenue is allocated to elected "District Assemblies". Politically appointed "District Chief Executives" manage development accounts in close collaboration with the Assemblies. Success in a community could galvanize political commitment to financing development investment in implementation. Community action thereby generated political support for development revenue to be invested in CHPS start-up costs, a process that was akin to social diffusion (Rogers, 1962). In this sense, the embedded science model was a "learning by doing" strategy that extended throughout the system of care – from community and district as a diffusion process to embedded research in learning districts, to national policy and programme planning processes in Accra.

Applying a Phased Development Process to Programme Reform

In keeping with the embedded science paradigm, the entire CHPS development process was controlled directly by the relevant Government of Ghana authorities. Although all districts in Ghana had joined the scaling-up process by 2008, GHS monitoring systems showed that a number of obstacles constrained the pace of implementation. CHPS was clearly a success-story, but its implementation was sub-optimal. District programme planning and national frontline worker hiring and training progressed more rapidly than the pace of implementing functional community-based services. By 2008, monitoring showed that nearly all CHPS implementation was limited to the 38 district teams that had participated in this exchange process in Nkwanta or Navrongo (Nyonator, *et al.*, 2011). The phased approach to developing CHPS has been revisited and applied to the process of launching and scaling up reform, to address the problems impeding progress. Four embedded research phases of the reform process are envisioned, of which two have been completed:

Revisiting Phase 1: A diagnostic appraisal. In response to the scaling up problem, the Ministry of Health (MOH) commissioned a diagnostic qualitative appraisal of implementation challenges representing a renewed utilization of Phase 1 qualitative appraisal (Figure 1, left hand arrows). Stakeholder interviews suggested that the health sector investment in community health post-construction was typically pursued without attention to ensure community involvement in the implementation process (Binka, *et al.*, 2009). Lacking community ownership to catalyze action, programme implementation depended upon expensive investment in construction. But since programme resources were severely constrained, the tendency of district management teams to prioritize construction was tantamount to slowing implementation.

But qualitative appraisals also showed that this problem was potentially resolvable. On the assurance that nurses would be deployed to start operations, communities would construct interim facilities with volunteers and donated resources. Some district managers arranged grassroots political support that catalyzed district assembly allocation of development financing of start-up costs. Others raised donations through community activities and faith-based organizations (Nyonator, *et al.*, 2005). Despite these episodes of success, the District Health Management Teams (DHMT) often lacked a coherent sense of strategic planning and purpose. This lapse deprived the programme of support for implementation that community social institutions were capable of providing.

Revisiting "Phase 2": Researching CHPS reform. In 2010, a research committee was convened by the Ghana Health Service (GHS) to review the 2009 MOH appraisal, and derive strategies for solving the problems that were brought to attention. This review led to a GHS decision to launch a plausibility trial that would assess the impact of strategies for accelerating community-based programme implementation. Known as the Ghana Essential Health Intervention Programme (GEHIP), the initiative assembled strategies for solving constraints to CHPS implementation in three districts of Ghana's Upper East Region (Awoonor-Williams, Bawah, *et al.* 2013). As with projects leading to GEHIP, this new initiative was embedded science: Its oversight was vested in the GHS Policy Planning, Monitoring and Evaluation Division (PPME), its implementation was the responsibility of the Regional Health Administration of the Upper East Regional Health Administration, and its research operation was the responsibility of a GHS research organization – the Navrongo Health Research Centre, with terms of reference from GHS regional health authorities.

The GEHIP team conducted a baseline appraisal of possible strategies for connecting community-based care with community social networks, governance systems, communication and consensus building mechanisms, and traditional leadership. This diagnostic qualitative appraisal set the stage for a new Phase 2 trial that focused on testing strategies for accelerating CHPS scale-up. GEHIP interventions tested the hypothesis that management operations could converge with traditional governance systems and grassroots political institutions in ways that would accelerate the scale-up of CHPS people-centered services.

Under the general direction of the GHS Regional Director of Health Services, GEHIP proceeded by selecting communities, engaging in dialogue with key leaders, and utilizing their advice to support CHPS implementation. Ongoing classroom leadership training for managers was supplemented with an award of $0.85 per capita per year to district accounts for three years. These resources, combined with leadership training, accelerated the pace of CHPS implementation from stagnation to 100 percent of targeted coverage (Awoonor-Williams, Sory, *et al.*, 2013) in four years. CHPS coverage in comparison districts was 25% at the 2010 baseline and 50% by the end of 2014. GEHIP also improved the range and quality of maternal and newborn health, as well as the implementation of a sustainable community-engaged emergency referral services system (Patel, *et al.*, 2016).

Revisiting Phase 3: Researching the utilization of research. Projects often end with a dissemination activity and the termination of funding arrangements that sustain teamwork. Ending research in this fashion dilutes prospects that the project could serve as a learning platform for catalyzing Nkwanta-like scale-up training and planning. To avoid this pitfall, follow-on to GEHIP has commenced to be termed as the Community-based Health Planning Services for Strengthening (CHPS+) project to connote an enhanced approach to CHPS scale-up. This new initiative, similar to the prior research processes, is embedded in the GHS administrative system with terms of reference to PPME. CHPS+ has developed "System Learning Districts" (SLDs) within the Northern and Volta Regions where demonstration and participatory planning activities can be employed to catalyze the spread of systems thinking, health systems development, and sustainable CHPS scale-up in all districts of participating regions. With the intent to make this work, district managers are invited to the SLD where GEHIP strategies are demonstrated, and "Catalytic grants" and training finance participants transfer GEHIP to the localities where they are based, thereby utilizing SLD as sites for nurturing the culture of health service excellence.

CHPS+ is also hosting university-based learning at SLD. Local universities follow a "Problem-based Learning" (PBL) academic model that provides students with learning opportunities in SLD that are enabled by project collaboration with district and regional health authorities. CHPS+ SLD also serves as GHS policy development

field stations where national knowledge activities can convert learning at the community level into lessons for senior officials and implementers throughout Ghana. A programme of exchanges integrates the process of SLD data capture, analysis, and use into peer learning operations so that CHPS+ project activities build capabilities that are decentralized, decision-oriented, and focused on resilient systems planning and district leadership development.

A programme of regional multi-level cluster survey research is combined with district rapid appraisal methods to demonstrate ways to monitor, evaluate, and utilize scaling-up processes. The phasing in of CHPS+ operations is generating data on systems variance in exposure to CHPS+ interventions. Seven treatment and seven comparison districts in each region are the focus of a stepped wedge transfer of GEHIP capabilities, with a baseline survey and a follow-up survey designed to provide core indicators of health and demographic outcomes, changes in outcomes over the period of observation, and association of change with exposure to project activities and inputs. Sampling has been powered by the region to permit comparative analysis of results emerging from contrasting contexts.

Anticipating Phase 4: Scaling up CHPS+. The utilization of GEHIP for national programme development will not await completion of CHPS+. The national health systems monitoring operation is already being modified to include GEHIP modules for monitoring programme inputs and service readiness. These monitoring tools are being implemented in CHPS+ regions and used to gauge progress with CHPS coverage and content and referral service implementation progress. Systems exposure data emerging from this capability are being linked to the surveys and used for systems analyses of the impact of the project on health outcomes.

Qualitative research is being conducted to gauge client, worker, and leadership reactions to CHPS+, ensuring "people-centered" implementation. Although this process has recently commenced, results are providing knowledge about how services are delivered, stakeholder reactions to interventions, and participatory advice on ways to improve the CHPS scaling up process. As such, CHPS+ represents an example of embedded implementation science for informing scaling up (Koon, *et al.*, 2012 and 2013), with "Phase 4" already functioning as an ongoing process of the national utilization of lessons from GEHIP.

DISCUSSION

Despite the progress that has been achieved with community-based primary health care development in every region and district of Ghana, much remains to be accomplished. Table 2 illustrates the contradictions that underlie evidence-based programming, each generating embedded research strategies in Ghana that have moved research utilization forward.

i) Scientific rigor. For several decades, the research utilization literature has directed attention to the practical importance of integrating research processes with the administrative responsibilities of key stakeholders (e.g., Glaser, 1986). But since research requires an element of strategic control over what is being tested, the administrative requirements of an implementation trial can be so artificial that results are irrelevant to deliberations on implementation. In Ghana, research systems have been separated from service implementation systems, with overall coordination governed by committees and mechanisms to ensure strategic integration, a key attribute to embedded science (Patel, *et al.*, 2016; Awoonor-Williams, *et al.*, 2013).

ii) Ownership. The science of research utilization has consistently demonstrated the importance of building collaboration of decision-makers and system implementers with scientists charged with research implementation and dissemination (Goldberg & Bryant, 2012b; Ghaffar, *et al.*, 2017; Winther-Schmidt, 2011)

iii) Relevance. The context of trials can influence the credibility of results (Crewe & Young, 2002). Systems research is sometimes optimized for success, with resources, site locations, staffing, and organizational arrangements contrived in ways that ensure that objectives are achieved. Operational optimization, however, can guarantee project success by employing strategies that are unsustainable at scale (Carr, 2008). To avoid this pitfall in Ghana, project activities have been placed in unpromising locations, with realistically constrained resources, and challenging operational designs, in the manner of selecting contexts that are optimized for failure. Elements of success that emerge despite contextual challenges acquire a degree of credibility that would not otherwise arise. Moreover, interregional dispersion of embedded replication projects has ensured that no particular ethnolinguistic group or ecological context overshadows the identity of results (Nyonator *et al.*, 2008; Nyonator, *et al.*, 2011).

iv) Simplicity. Evidence-based change is an application of complexity science (Plsek & Greenhalgh, 2001). But, phases, milestones, and processes implied are complex to document. Surmounting this challenge in Ghana, field demonstration is combined with realistic financing that enables participants to pilot the system they are learning to manage. And mixed method research is used to ensure that evidence about implementation processes is integrated into the managerial dissemination of knowledge about outcomes and impact (Binka, *et al.*, 1995; Fajans, *et al.*, 2006; Simmons, *et al.*, 2007; Adongo, *et al.*, 2014).

Implementation science attributes	Implicit challenges and contradictions	CHPS+ strategies for resolving contradictions
1) Scientific rigor. Study designs should be scientifically rigorous and grounded in theory.	Constructing the counter-factual is a challenge in real-world settings. (Bärnighausen *et al.* 2012) (Mills, *et al.*, 2008; Mills, *et al.*, 2006).	Plausibility trials with appropriate statistical adjustment of results (Binka, *et al.*, 1995; Awoonor-Williams, *et al.*, 2004; Awoonor-Williams, Bawah, *et al.*, 2013; Akosa, *et al.*, 2003).
2) Ownership. Embed research into operations with implementers in a position to utilize results.	Leadership malaise in the implementing agency can permeate the research system, diluting rigor and compromising research implementation (Cummings, *et al.*, 2007).	Integrate implementation of research with the host institutional structure (Patel, *et al.* 2016; Awoonor-Williams, Elias Kavinah Sory, *et al.*, 2013).
3) Relevance. To foster credibility of results for large-scale systems application, implementation science is appropriately placed in challenging "real-world" contexts.	Bureaucratic contexts where implementation science is needed most are settings where such research is most challenging to conduct (Kitson, *et al.*, 2008).	Disperse replication research in contrasting cultural and ecological contexts (Nyonator, *et al.*, 2008; Nyonator, *et al.*, 2011), an approach that connotes "scaling down to scale-up."
4) Simplicity. To optimize results for impact on policy and action ensure that results are simple to interpret and understand.	Implementation science is intrinsically complex (Plsek & Greenhalgh, 2001). Integration is complex to research, but essential for implementation (Martin & Félix-Bortolotti, 2010; Stange, 2009; Gilson, *et al.*, 2011).	Employ mixed method research and knowledge management to promote understanding of process and outcome (Binka, *et al.*, 1995; Fajans, *et al.*, 2006; Simmons, *et al.*, 2007; Adongo, *et al.*, 2014)
5) Replicability. Research management strategies should be relevant to large scale operations.	Rigorous research requires a degree of focus and leadership that may be unavailable in the large scale system (Haruna, 2009) .	Integrate health systems leadership with traditional leadership (Nazzar, *et al.*, 1995; F. K. Nyonator, *et al.*, 2005).
6) Catalytic potential. Implementation science is a tool for guiding or catalysing planned organisational change.	Primary science generates knowledge about impact without addressing the need for knowledge about organizational change, knowledge management, and advocacy (Ghiron, *et al.*, 2014; Ioannidis, 2005).	Developed "lead districts" each with "lead communities" for catalyzing the geographic spread of implementation (F. K. F. Nyonator, *et al.*, 2005).
7) Fidelity. Sustainability is fostered by demonstration of post-scale-up success and maintaining evidence-based innovation.	Failure is more sustainable than success (Hironaka, 2010). Management challenges associated with sustaining scale-up are unpredicted by research operations.	Avoid advocacy focusing solely on "success" without also publicizing challenges and failure.(Easterly, 2009; F. K. Nyonator, *et al.*, 2005)
8) Affordability. Results are most likely to be utilized if costs are clear and replicability is established.	Organizational change is more costly to sustain than the direct cost of research (Johns & Torres, 2005).	Monitor costs and restrict research-based implementation financing to affordable replicable activities (McIntyre, *et al.*, 2008; Akazili, *et al.*, 2012).
9) Timeliness. Implementation science is most effective if it generates results with dispatch.	Organizational change requires timelines that are inconsistent with research funding and support (Murray, *et al.*, 2007; Phillips, Simmons, and Simmons, 1991).	Phased research process that fosters continuous utilization and action (Awoonor-Williams, Elias Kavinah Sory, *et al.*, 2013; Awoonor-Williams *et al.*, 2010).
10) Knowledge management. Effective knowledge management and advocacy sustains implementation science.	Science is disseminated by modes of communication that have limited currency among donors, decision-makers, implementers, and managers (Campbell, 2010; Sveen, *et al.*, 2007).	Develop a knowledge management system for communicating research results; build participatory learning and exchanges into research operations (Awoonor-Williams, *et al.*, 2015a).
11) Systemic impact. Systems thinking is essential to impacting on organizational development (DeSavigny & Adam, 2009; DeSavigny, Kasale, Mbuya, & Reid, 2008).	Systems research requires multilevel longitudinal data that span functional components of organizations. Requisite data are complex to capture, manage, and analyze. (World Health Organization, 2007; Plsek & Greenhalgh, 2001; Moerbeek, M., van Breukelen, G.J.P., & Berger, 2001).	Augment workshops for skill development with team orientation for implementation development, with counterparts demonstrating change processes that prepare teams for changing operations (Awoonor-Williams, *et al.*, 2013; F. K. F. Nyonator, *et al.*, 2005)
12) Resilience. Implementation science should foster system resilience (Kruk, *et al.* 2015)	Resilience is difficult to measure and is more relevant to emergency preparedness than to health systems strengthening more generally. (Agyepong, Kodua, *et al.*, 2012) (WHO, 2012)	Develop indicators of resilience and integrate resilience monitoring into health information management. Integrate knowledge management systems into research dissemination and monitoring operations.

viii) Replicability. Scalability is often an afterthought rather than a process that is antecedent to research (Ghiron, *et al.*, 2014). In Ghana, general policy and programmatic decisions to scale-up were taken prior to the initial research pilot phase. This orientation provided a natural framework for the utilization of results. Structural integration is important: Units of observation in the research programme should conform to managerial decision-making units of the system that results aim to reform. Implementation of the CHPS research operations anticipated the need to integrate health systems leadership with traditional leadership so that district diffusion of implementation would naturally flow within participating districts – an approach termed as "guided diffusion" (Nazzar, *et al.*, 1995; Nyonator, *et al.*,

2005). Catalytic potential. Scaling-up rarely occurs as a well thought through initiative from the onset of action (Maher & Cometto, 2016). CHPS+ research is therefore scaled-down to tractable levels of managerial action; the spread of CHPS is scaled down at each participating district to ensure that system learning can be established before large-scale implementation proceeds – a process of embedding research operations into tractable administrative units for the purpose of building implementation capacity.

ix) Fidelity. Integrated decision-making has involved project governance mechanisms, steering committees, and collaborative arrangements that establish policy community ownership of research, ensuring that activities are not drifting away from reality. But mechanisms were also put in place to insulate research teams from bureaucratic constraints. GEHIP, based its technical team at the Regional Health Directorate with terms of reference to the Regional Director of Health Services. However, it had autonomous accounts, staffing, and logistics capabilities that permitted an element of operational flexibility that the regional programme lacked. Of particular importance are mechanisms for disseminating lessons about failure and constraints among decision-makers and programme stakeholders (Easterly, 2009; Nyonator, *et al.*, 2005). Early in the CHPS development era, the GHS circulated a newsletter series known as "What Works? What Fails" to provide balanced information on the process of launching operations and the challenges that implementers were encountering.

x) Table 2: Attributes of implementation science and associated contradictions with corresponding systems research strategies in GhanaAffordability. Critical to the utilization of research is evidence that operational replication is affordable (Edejer, 2003). Health economics research has been a key component of all stages and projects of the Ghana primary health care development programme (McIntyre, *et al.*, 2008; Akazili, *et al.*, 2012).

xi) Timeliness. Continuous and timely provision of information is critical to informed decision-making (Campbell, 2010). But research dissemination requires mechanisms and media that consume time to produce and disseminate. To address this problem, the Ghana Health Service (GHS) integrates project reporting into routine communication mechanisms so that staff meetings, national policy meetings, local conferences and routine reports have continuous access to research reports on process, results and outcomes (Damschroder, *et al.*, 2009). Research is conducted in continuous phases rather than projects with start and end dates. This continuous utilization and action process generates learning and capacity to change operations (Awoonor-Williams, *et al.*, 2013; Awoonor-Williams, *et al.*, 2010)

xii) Knowledge management. Results emerging from well-designed science can be mismanaged as knowledge to be conveyed to decision-makers (Curran, *et al.*, 2011). To address this problem in Ghana, international responsibility for the dissemination of science is shared with the policy makers who have responsibility for using this knowledge for programme development. Research is embedded in the decision-making system (Koon & Mayhew, 2013). Building on the knowledge management partnership that GEHIP has piloted, CHPS+ involves frontline workers and community stakeholders in exchanges between health systems staff at various operational levels of the system. Exchanges are designed to generate knowledge management as a "bottom up" learning process at SLD while contributing material to a series of documents, news articles, web traffic, site visits, and other forms of awareness building for developing participatory knowledge of the CHPS system (Awoonor-Williams, *et al.*, 2015a).

xiii) Systemic impact. Frameworks embracing systems thinking in programme planning gained currency with the dissemination of the WHO (2007) systems strengthening framework. Widely cited publications have clarified implementation criteria and strategies for integrating systems thinking into research designs (deSavigny, *et al.*, 2009). Apart from a few examples, however, systems strengthening trials remain rare (deSavigny, *et al.*, 2008; Awoonor-Williams, *et al.* 2013; Ramsey, *et al.*, 2013; Munce, *et al.*, 2013; Sherr, *et al.*, 2013), in part, because of the cost, complexity, and organizational challenges of systems research (Bloom, 2014). However, as the Ghana case has showed, multi-method teamwork can offset this challenge. By integrating inter-disciplinary expertise into systems inference and learning (El-Jardali, *et al.*, 2012), the Ghana approach involves collaboration of implementing units with teams engaged in inter-disciplinary investigation of hierarchy, structure, teamwork, and function (Krumholz, *et al.*, 2014; Dalaba *et al.*, 2016).

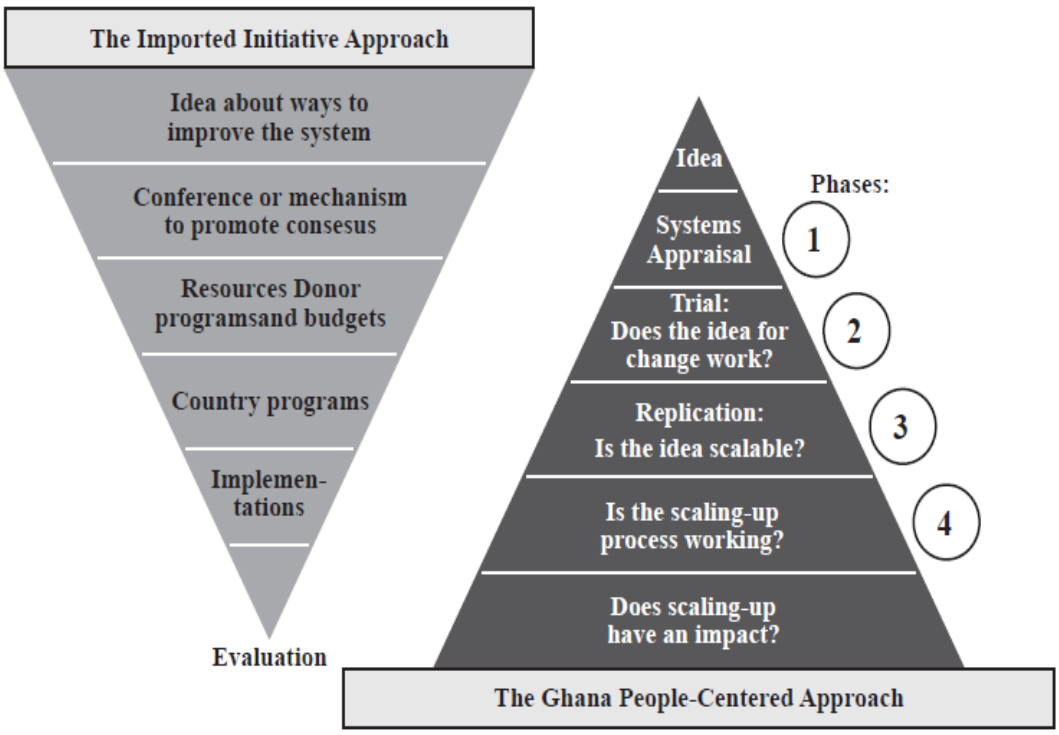
xiv) Resilience. The Ebola epidemic, catalyzed global concern about health systems capabilities to respond to emergencies without loss of general service delivery capabilities. Resilience in the context of emergency preparedness has translated into recommendations for strategic planning and resilience focused implementation science (Kruk, *et al.*, 2015). Resilience as an organizing principle is associated with measurement challenges (Sheikh, *et al.*, 2011). Yet indicators associated with leadership, decentralization, and flexiblity can be associated with research designs. New research programmes of

the GHS are designed to link university based degree training to problem-based learning so that the science of flexibility and adaptability is demonstrated and understood by health professionals at all operational levels.

CONCLUSION

Over the decades that Ghana has been engaged in the process of developing its community-based primary health care programme, its programme leaders have shifted its implementation research strategies and designs, while sustaining the paradigm of embedded research throughout the development process. While CHPS programming has been grounded in results of the Navrongo experiment, multiple replication efforts pursued elsewhere have guided scaling up policy. And, as the process of scaling up progressed, research-guided reviews of the programme have structured procedural reform, sustaining embedded science as a guiding principal of management. As a national programme, CHPS aims to bring health services to every Ghanaian doorstep by aligning health sector policy, evidence, and action with vibrant social traditions of community leadership, communication, and volunteerism. Pursuing the goal of people centered programming has involved embedding implementation science with routine health system management (Ghaffar, *et al.*, 2013; Ghaffar, *et al.*, 2017). Guided by implementation science, CHPS has been adaptive to changing needs and to the diversity of Ghanaian social institutions and continuously engaged in programmatic reform. People-centered programming represented by this example is robust to shifts in donor priorities and changes in national political leadership. And, its evidence-based orientation has enabled leaders of the programme to understand problems and undertake appropriate reforms in response to evidence.

FIGURE 2: THE GHANA PEOPLE CENTERED PROCESS VERSUS THE TOP-DOWN APPROACH



If the CHPS theory of change is sustained, the research process that guides this programme will never end. Systems learning will be continuous in Ghana where community-based primary health care development started with a commitment to scale-up the concept, without a predetermined agenda defining means of implementing this goal. This community-driven process contrasts with international initiatives that pre-define strategy, build consensus for action through international partnership arrangements, roll-out externally contrived programmes, and evaluate the impact of programs as an after-thought rather than a continuous component of the action agenda (Figure 2, left hand panel). By guiding action with questions, stages, and implementation science, the Ghana model contrasts with imported programme designs (Figure 2, right hand panel). The phased processes of open systems research, information utilization, evidence sharing, and consensus building combines field investigations with programming, leading to a sustainable community-based primary health care programme. Taken as an official government programme that has institutionalized research as a component of the official policy agenda, Ghana's application of implementation research has translated a theory of change into change itself.

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