


The Role of Implementation Science in Advancing Resource Generation for Health Interventions in Low- and Middle-Income Countries

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ABSTRACT: Low- and middle-income countries (LMICs) bear the brunt of communicable and non-communicable diseases and experience higher mortality and poor health outcomes compared to resource-rich countries. Chronic resource deficits in LMICs impede their ability to successfully address vexing health issues. Implementation science provides researchers with an approach to develop specific interventions that can generate and/or maximize resources to facilitate the implementation of other public health interventions, in resource-constrained LMIC settings. Resources generated from these interventions could be in the form of increased health workers' skills, task shifting to free up higher-skilled health workers, increasing laboratory capacity, and using supply chain innovations to make medications available. Pivotal to the success of such interventions is ensuring feasibility in the LMIC context. We selected and appraised three case studies of evidence-based resource-generating health interventions based in LMICs (Zambia, Zimbabwe, and Madagascar), which generated or maximized resources to facilitate ongoing health services. We used a determinant implementation framework—Consolidated Framework for Implementation Research (CFIR) to identify and map contextual factors that are reported to influence implementation feasibility in an LMIC setting. Contextual factors influencing the feasibility of these interventions included leadership engagement, local capacity building and readiness for research and implementing evidence-based practices (EBPs), infrastructural support for multilevel scale-up, and cultural and contextual adaptations. These factors highlight the importance of utilizing implementation science frameworks to evaluate, guide, and execute feasible public health interventions and projects in resource-limited settings. Within LMICs, we recommend EBPs incorporate feasible resource-generating components in health interventions to ensure improved and sustained optimal health outcomes.

KEYWORDS: Resource generation, low-and-middle income countries, implementation science, Consolidated Framework for Implementation Research, implementation science outcomes, feasibility

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Background

Low- and middle-income countries (LMICs) bear most of the global health burden, and by World Bank economic and development indicators, have significant resource constraints that limit their ability to tackle these health issues—a phenomenon known as inverse care law.¹ With inverse care law at play, LMICs experience higher amenable mortality, that is, “*the mortality that existing effective healthcare technologies could eliminate if they were delivered successfully to all those who can benefit*,” which have a detrimental impact on their populations.^{2,3} Tackling this reality in LMICs is complicated by the time delay in translating evidence-based health interventions to real-world settings and the existing deficit of resources to effectively implement and sustain public health interventions.^{1,4}

Implementation science is focused on finding “what works,” “why it works,” and “how it can be applied” to benefit populations by improving and maximizing the health impact of evidence-based practices (EBPs).⁵ In this regard, EBPs would be the integration of the “*conscientious, explicit, and judicious use of current best evidence in making decisions about the care*

of individual patients” and individual clinical/professional expertise. Another objective of implementation science is evaluating the successful delivery of EBPs⁶ that ideally should attain maximum reach, efficacy, adoption, implementation, and sustainability within the populations the EBPs are being delivered.⁷ Maximum adoption is context-specific and attainable if researchers and implementers are intentional about incorporating elements that can achieve successful implementation in the design, planning, and execution of the intervention(s) via an iterative process.⁶ Some desired outcomes of the implementation of EBPs include acceptability, feasibility, and sustainability of the intervention within the context and target population(s).⁶

There is a growing body of implementation science theories, models, and frameworks that serve to: “(i) describe and/or guide the process of translating research to practice, (ii) understand and/or explain what influences implementation outcomes, and (iii) evaluate implementation.”⁸ One framework that can explain the vital role context plays in achieving implementation success in specific settings, such as LMICs is the Consolidated Framework for Implementation Research (CFIR).^{9,10} CFIR consolidates



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overlapping constructs from different implementation theories (n=19) into one meta-theoretical, determinant framework, with which researchers can identify the specific domains of constructs, most relevant to their implementation setting in order to guide/evaluate/explain implementation processes and outcomes.⁹ As a determinant framework, CFIR is useful for identifying factors that facilitate and hinder implementation.⁸ CFIR consists of five main domains namely: “Intervention Characteristics,” “Outer Setting,” “Inner Setting,” “Characteristics of Individuals,” and “Process.” Of these five domains, “Outer Setting” and “Inner Setting” consist of constructs that characterize contextual factors to consider in implementation work. “Outer Setting” “includes economic, political, and social context within which an organization resides” and “Inner Setting” “includes features of structural, political, and cultural contexts through which the implementation process will proceed.” The political context in “Outer Setting” refers to political influences from the larger society where an intervention is being implemented while the political context in “Inner Setting” refers to the organizational politics in the organization/setting housing an implementation effort.⁹ Other implementation science frameworks exist but their use in LMICs has been very limited or has not yet occurred.¹¹

Current literature highlights inadequate use of implementation science frameworks to develop, execute, and evaluate EBPs in LMICs, which could explain the striking deficit of sustainable EBPs in these settings.^{12,13} This gap in knowledge and application of implementation methodologies results in loss of resources (time, money, and personnel efforts) and development of unsustainable and cost-ineffective interventions in LMICs, which results in a detrimental impact on population health outcomes.¹²⁻¹⁴ Moreover, the potential for implementation science to be more relevant in LMICs for developing and executing sustainable strategies that generate resources or maximize the limited resources available in these settings is essential to bridge disease prevention and management gaps in these countries.⁵

In this paper, we continue the discourse from the 2018 commentary by Yapa and Bärnighausen on implementation science in resource-poor countries and communities by applying CFIR to highlight specific ways implementation science can be used to understand and advance interventions, which generate and/or maximize resources to facilitate other health interventions in LMIC context.³ In applying CFIR, we focus on the role of contextual domains to explain contextual influence on the implementation feasibility of resource-generating/maximizing interventions. Yapa and Bärnighausen explained that the theoretical frameworks that support implementation science typically consider resources to be a significant contextual factor used to assist with important program elements such as predicting feasibility, explaining success/failure, adapting EBPs to fit local constraints, and designing an appropriate process to account for these constraints. It is their argument, however, that for resource-poor settings, resources are much more central and as such are

viewed as primary research objects instead of contextual factors. Furthermore, they state that within this paradigm of implementation science studies that distinguish resources as a focal point, many researchers aim to investigate new ways to generate resources in order to facilitate the application of EBPs to routine care. Such strategies include the use of tele-education and telemedicine to advance the skillset of higher-skilled workers, task shifting to increase the workforce and alleviate the strain on higher-skilled workers, and increasing laboratory capacity through new technologies and supply chains. A few other studies focused on finding ways to maximize resources by changing behavior and utilization.

Moreover, Yapa and Bärnighausen identified three approaches for implementation science in resource-poor countries and communities. First, constraints found in resource-poor countries and communities are a motivating element for great innovation in intervention processes and methods. These limitations in resources force necessary creativity—in order to circumvent challenges—that would not be possible otherwise. Second, there is an opportunity for reverse innovation that transfers strategies adapted first in resource-poor countries and communities to resource-rich settings. And finally, there is a significant potential for collaboration between policymakers in resource-poor countries and communities and implementation scientists.

Pre-existing financial constraints of resource settings are the most pragmatic of the three approaches discussed by Yapa and Bärnighausen for resource-poor countries and communities to increase financial resources for healthcare.³ Table 1 provides categories of the different types of resource generation strategies from a review of several health interventions implemented in resource-poor settings conducted by Yapa and Bärnighausen.³ They also presented implementation science as a fitting paradigm to advance this approach. For this paper, we define resource generation as “*the creation of new resources to deliver effective health interventions given the existing financial constraints*” based on Yapa and Bärnighausen’s recommendations. This definition is a coherent summation that aligns with similar definitions used by the World Bank, World Health Organization (WHO), and other international organizations working in resource-constrained settings.³ In the context of LMICs, assessment of feasibility is also needed during the pre-implementation and design phase of the intervention, especially if the eventual outcome is to generate or maximize resources to facilitate other health interventions. Systematic reviews of the literature for non-communicable diseases (NCDs) suggest that this meticulous step in pre-implementation is needed to properly plan and execute implementation research studies, which can achieve multiple goals including resource generation.^{15,16}

Methods

We conducted a case-studies review of interventions that generated or maximized resources to facilitate effective public health

Table 1. Yapa and Bärnighausen's resource generating categories.

1. Creating resources
Definition: Resources are primary research objects because without the physical capacity to deliver EBPs, an intervention cannot take place.
Examples: Focuses on advancing and testing novel strategies to (1) increase human resources by using tele-education and telemedicine to improve or deliver higher skills to workers, (2) freeing up human resources with tools such as task-shifting, or developing a new model of care utilizing new technologies. Other examples include increasing laboratory capacity and supplies with new technologies and increasing the supply chain via innovations that can increase the availability of medicines
2. Changing behavior
Definition: Focuses on approaches to change health worker behavior and utilization of resources to promote more efficient delivery of EBPs into routine care. Very little of this research is conducted in LMICs. More research is needed to investigate how to best adapt these approaches that have been proven effective in resource-rich settings to resource-poor settings while considering constraints such as resource gradient as well as political and institutional factors
Examples: <i>Educational Materials; Internet-based learning/training; Competency-based training, Meetings/Workshops; Educational Outreach; Local opinion leaders; Audits and Feedback; Reminders; Tailored interviews.</i>
3. Creativity/reverse innovation
Definition: Creativity is an aspect of innovation used to circumvent limitations faced by resource-poor countries and communities and can stimulate great innovations that can help advance the field of implementation science. Visionary ideas to address resource scarcity can lead to reverse innovations for the development of effective new implementation strategies that are derived from resource-poor settings and then implemented in resource-rich settings.
Examples: <i>Rural health service delivery; Skills substitution; Decentralization of management; Creative problem-solving; Education in communicable disease control; Innovation in mobile phone use; Low technology simulation training; Local product manufacture; Health financing; Social entrepreneurship</i>
4. Methods innovations
Definition: Methods by which implementation research strategies are implemented in resource-constrained settings. Resource scarcity encourages the advancement of methods of implementation that can deliver the best health care to as many people as possible.
Examples: (1) Stepped wedge design in which clusters of the population are exposed to the intervention at sequenced time intervals rather than a one-time variant which is typical of the traditional parallel-arm trial. All the communities in the study receive the intervention over time, which increases equitability and acceptability. (2) Novel strategies such as the use of mobile phones to collect data. (3) Quasi-experiments can also be very effective as an evaluative tool for implementation science interventions because of the variation that naturally occurs with scale-up due to resource scarcity
5. Increasing capacity for research
Definition: Research capacity in LMICs must be increased by creating and educating scientist researchers in LMICs and creating programs at local institutions that train the next generation of implementation scientists.
Examples: Important opportunity to increase capacity for implementation science are massive open online courses (MOOCs), which provide (free or inexpensive) training in implementation science through online learning platforms
6. Policy for science
Definition: Scarcity of healthcare resources in LMICs has created a growing culture of "demonstration projects" aimed at testing the delivery of research innovations. Implementation research projects can have a greater impact on LMICs by engaging policymakers and providing a significant opportunity for close collaboration between implementation scientists and policymakers who are eager to aid with implementation research projects aimed at informing national and local policy.
Examples: Policymakers can be directly involved in all facets of the research process by working with implementation scientists in study development as well as interpretation and assessment of study results. They can also have leading roles in setting research agendas and as principal investigators.

interventions in LMICs. A systematic search using PubMed, Google Scholar, and Cochrane library was conducted using the following terms: Implementation Science + Resource-Poor, Implementation Science + LMICs + Resource-Poor, Resource Generation + Implementation Science + LMICs, Evidence-Based Practices in Resource-Poor Setting, Implementation Science + Task Shifting + LMICs, and Mental Health + Task Shifting + LMICs. Inclusion criteria were articles and studies that took place primarily in LMICs and had a resource generation

component. Exclusion criteria were studies that were implemented in high-income countries and did not have a strong focus on resource generation. We sampled three public health interventions from the pool of articles (see Supplemental Appendix) that emerged from the literature search (Table 2). The three studies chosen amongst several LMIC-based, resource-generating interventions, addressed a health need, and generated or maximized resources as part of the intervention. These studies were noteworthy examples of successful implementation science projects in

Table 2. Summary of study characteristics.

STUDY AND AUTHOR	COUNTRY	PRIMARY OUTCOME	SAMPLE SIZE	STUDY DURATION	INTERVENTION
Riders for Health Mehta et al ¹⁷	Zambia	Increase the average number of outreach trips per health worker per week by 0.9 trips	116 community health workers	Baseline (September 2011-January 2012) (5 mo) Intervention (February 2012-March 2014) (25 mo)	Health system supply chain intervention which involved systematic motorcycle management
Friendship Bench Chibanda et al ¹⁸	Zimbabwe	The pilot study showed that after 3 to 6 wk of receiving PST sessions, clients average SSQ scores decreased from 11.3 to 6.5 points. In the effectiveness trial, the intervention group showed less symptoms of common mental disorders compared to the control group. The SSQ-14 mean score was 3.81 in the intervention group vs 8.90 in the control group; mean difference = -4.86 and adjusted risk ratio of 0.21	In the pilot study, 355 participants were enrolled. In the effectiveness trial, 573 participants (286 in the intervention group and 287 in the control group) were enrolled.	Pilot study: intervention was delivered for 6 wk Effectiveness trial: intervention was delivered in 6 wk with a 6 mo follow-up interview post intervention	Task shifting and problem-solving therapy (PST) for managing common mental health disorders, coupled peer support sessions.
Marie Stopes Voucher Program Burke et al ¹⁹	Madagascar	Reduce financial barriers to family planning access for young people	MSM distributed 58417 vouchers, of which 43352 were redeemed	1 y	e-Voucher to redeem package of family planning and sexual and reproductive health services

LMICs and each one tackled a different emergent health concern. A literature search of emerging health concerns in LMICs and solutions to tackle them was also conducted and among the top issues were reproductive/sexual health, family planning, mental health concerns, and problems with access to care. Yapa and Bärnighausen's categorization of resource generation was then applied to this sampling. We used CFIR to identify and map contextual factors that are reported to influence the feasible implementation of these case studies, given an LMIC setting. We synthesized findings from these interventions with our appraisal for contextual factors to spotlight the broader implications of utilizing implementation science methodology in the development and implementation of interventions that address resource availability and generation for public health in LMICs.

Study Descriptions

The sampled studies addressed healthcare delivery services, mental health prevention and psychosocial support, and family planning services in Zambia, Zimbabwe, and Madagascar respectively (Table 2). Each study utilized a different strategy to generate resources as a core component of the evidence-based interventions being implemented; each strategy was connected to at least two of Yapa and Bärnighausen's categories of resource-generation. We provide brief descriptions of the sampled studies as follows:

“Riders for Health” in Zambia is a field trial of systematic motorcycle management and healthcare delivery that took place in Zambia.¹⁷ This trial falls under the Yapa categories of (i) creating new resources by using supply chain innovation to increase the availability of medicines, personnel, and equipment to remote villages and (ii) changing behavior and utilization of resources by training health workers to better manage their motorcycles.³ Riders for Health investigated whether managed transportation, in the form of motorcycles, improved outreach-based health service delivery to rural village populations. The study design was an interrupted time series with randomized district-level clustering. Table 2 provides further details about the study scope and outcomes. The main intervention targeted low-resource communities and individuals who faced additional geographic barriers to healthcare access, which translates to transportation and financial challenges such as direct cost of travel to health facilities and missing paid work to make these trips to health facilities. Study results showed that the average number of outreach trips per health worker to rural villages, which is the primary measure of health worker productivity, more than tripled as a result of systematic management; from just one trip each month during the baseline period to one trip each week during the intervention period.¹⁷ There was also an increase in health workers'

productivity by 20.5 more patient visits in experimental districts for the duration of the study.

The Friendship Bench in Zimbabwe is a psychosocial project aimed to determine the effectiveness of task shifting in mental health delivery using local grandmothers as lay health workers (LHWs).¹⁸ This intervention fell under the Yapa categories of (i) creating new resources by freeing up human resources via task shifting to clients, that is, grandmothers who lived in the communities, and (ii) creativity/resource generation as the “Friendship Bench” has been adapted to some resource-rich countries.^{3,20} This cluster-randomized trial was developed as a low-cost strategy to address the truncated success of delivering care for mental health in Zimbabwe, which was attributed to the reliance on an overstretched nursing staff, and lack of supervision of such care.^{21,22} These community grandmothers are LHWs trained to listen to and support patients living with anxiety, depression, and other common mental disorders.¹⁸ The grandmothers met with patients on benches placed in a discreet area outside of the primary care clinics in Harare, Zimbabwe. The intervention starts with screening people with the Shona Symptoms Questionnaire (SSQ-14) and Patient Health Questionnaire (PHQ-9) to determine the level of common mental health disorders and risk for depressive symptoms, respectively, and referring individuals who exhibited scores higher than the normal cut off to physicians for further evaluations or LHWs for management.¹⁸ The trained LHWs provided 6 sessions of individual problem-solving therapy (PST) to each patient and referred those at risk of suicide, to their immediate supervisors.¹⁸ The pilot study showed that after 3 to 6 weeks of receiving PST sessions, clients’ average SSQ-14 scores decreased from 11.3 to 6.5 points.²² In the effectiveness trial, there was a mean score difference of -4.6 (3.81 vs 8.90) in the SSQ-14 scores and -6.36 (4.50 vs 11.01) in the PHQ-9 scores between clients with depression or other common mental disorders who received PST through the Friendship Bench and the control (enhanced usual care).¹⁸ The Friendship Bench intervention was shown to be well suited to improve health outcomes among highly vulnerable individuals.

Marie Stopes Madagascar (MSM) is a youth voucher program implemented by Marie Stopes International (MSI) to improve access to quality family planning services for youths, 15 to 19 years old in Madagascar.¹⁹ This program falls under Yapa categories of (i) creating new resources by freeing up human resources through task shifting via community health workers; (ii) methods innovation as the study utilized mobile phone to collect data and disseminate information relating to family planning; and (iii) creativity category because of the use of health financing innovation to increase affordability and access to family planning services.³ The program used an outreach method to tackle the high rate of unplanned pregnancies, financial barriers to accessing family planning services, lack of knowledge about various methods of family planning and their importance to women’s reproductive health, and lack of

community awareness about sexual and reproductive health.¹⁹ MSM reached local residents by collaborating with mobile clinics and community leaders to provide awareness about family planning, birth control, and reproductive/sexual health, as well as distribute vouchers redeemable at Blue Star Network clinics, a private-sector third party healthcare provider that comprised of a network of private physicians trained to provide quality family planning services. This study is also a depiction of successful community outreach on health care outcomes. This intervention successfully distributed 58 417 vouchers of which 74% of them were redeemed at Marie Stopes International’s social franchise brands. Of those who received the vouchers, 96% of them were youths 20 years and younger—that is, the intervention’s target population and reached 10 of the 22 regions in the country.

Appraisal of Contextual Factors Influential to Feasibility of Resource-Generating Studies

Using CFIR’s contextual constructs (see Table 3); there was reported evidence of contextual factors that influenced the feasibility and effectiveness of the studies, either as facilitators or barriers. Most of the factors identified were contextual facilitators of feasible implementation and effectiveness of these interventions. Of the 5 main Inner Setting constructs, Readiness for Implementation, featuring 3 sub-constructs of Leadership Engagement, Available Resources, and Access to Knowledge and Information recorded an abundance of evidence across all 3 studies. For instance, in every intervention, training was provided as a resource through building local capacity for implementation. Additional resources include the provision of space (benches on clinic grounds for Friendship Bench-Zimbabwe), provision of fuel and motorcycle maintenance services for Riders- Zambia, and training and accreditation of MSM Blue Star social franchisees in Madagascar to supply services for the youth vouchers. There was also evidence of viable stakeholder engagement, especially with leadership from Ministries and Departments of Health and clinical leadership at health facilities. Leadership engagement ranged from a close working relationship in developing and implementing the interventions as seen in the Friendship Bench in Zimbabwe to consulting and gathering information from clinical managers as seen in Riders-Zambia. Implementers easily accessed information and knowledge about the intervention via a network of trained supervisors and clinicians and provision of manuals for LHWs for Friendship Bench-Zimbabwe, and quality assurance monitoring and support for Blue Star social franchisees in MSM.

Likewise, several other facilitators identified in all 3 studies mapped on to another inner setting construct, namely Implementation Climate. Implementation Climate has 6 sub-constructs of which “Compatibility” and “Goals and Feedback” characterized most of the facilitators linked to this construct. For instance, across all 3 studies, an intentional effort was made to adapt the intervention and implementation process to fit the

Table 3. Mapping contextual facilitators and barriers to CFIR inner and outer setting constructs.

CFIR CONSTRUCTS	DEFINITIONS	STUDY 1 (RIDERS FOR HEALTH-ZAMBIA)	STUDY 2 (FRIENDSHIP BENCH-ZIMBABWE)	STUDY 3 (YOUTH VOUCHERS-MARIE STOPES MADAGASCAR)
OUTER SETTING				
<p>Patient needs and resources</p>	<p>The extent to which patient needs, as well as barriers and facilitators to meet those needs, are accurately known and prioritized by the organization</p>	<p>+ Intervention addressed the direct cost of travel to health facilities and missing paid work to make these trips to health facilities</p>	<p>+ Friendship bench also offered local income-generating avenues (peanut butter making and recycling) to patients in financial distress</p>	<p>+ Free vouchers reduced financial barriers to accessing family planning services for youths</p>
<p>Cosmopolitanism</p>	<p>The degree to which an organization is networked with other external organizations</p>	<p>+ Riders has been implemented in 6 other countries, besides Zambia by the Riders' Team</p>	<p>NR</p>	<p>+ Engaging private sector social franchisee network to supply services</p> <p>+ Collaborating with other community organizations in raising awareness about the intervention and mobilizing youths to participate</p>
<p>Peer pressure</p>	<p>Mimetic or competitive pressure to implement an intervention; typically because most/other key peer or competing organizations have already implemented or are in a bid for a competitive edge</p>	<p>NR</p>	<p>NR</p>	<p>+ MSM drew lessons from similar Marie Stopes youth voucher program done in Zimbabwe to develop this intervention</p>
<p>External policies and incentives</p>	<p>A broad construct that includes external strategies to spread interventions, including policy and regulations (governmental or other central entity), external mandates, recommendations and guidelines, pay-for-performance, collaboratives, and public or benchmark reporting</p>	<p>NR</p>	<p>NR</p>	<p>NR</p>
INNER SETTING				
<p>Structural characteristics</p>	<p>The social architecture, age, maturity, and size of an organization</p>	<p>+ Health facilities with existing government-operated fleet systems: 8 districts, randomly selected 116 facilities and health workers for trial</p>	<p>+ Clinics chosen were some of the largest in Harare (urban), accessible, had good mobile network coverage and reliable data on stratification variables</p>	<p>+ MSM has been operational since 1992; it is the largest non-state provider of voluntary planning and sexual and reproductive health services</p> <p>+ Delivers services through 150 private and 140 public social franchisees in all 22 regions of the country</p>
<p>Networks and communication</p>	<p>The nature and quality of webs of social networks and the nature and quality of formal and informal communications within an organization</p>	<p>+ Health workers reported progress with intervention via weekly surveys administered by the study's data collectors</p>	<p>+ Use of SMS messages between LHWs and participants, home visits</p> <p>+ Provision of a daily peer support group for LHWs to supervise their activities, in addition to weekly group supervision from a trained nurse</p>	<p>+ SMS reporting of voucher claims and mobile money payments to social franchisees</p> <p>+ Software update to integrate the youth voucher program</p>

(Continued)

Table 3. (Continued)

CFIR CONSTRUCTS	DEFINITIONS	STUDY 1 (RIDERS FOR HEALTH-ZAMBIA)	STUDY 2 (FRIENDSHIP BENCH-ZIMBABWE)	STUDY 3 (YOUTH VOUCHERS-MARIE STOPES MADAGASCAR)
Culture	Norms, values, and basic assumptions of a given organization	NR	+Elderly women were perceived as mature and trustworthy, making them more contextually relevant as LHWs and likely to contribute to the formation of a strong therapeutic alliance for participants	NR
Implementation climate (sub-constructs are: tension for change, compatibility, relative priority, organizational incentives and rewards, goals and feedback, learning climate)	The absorptive capacity for change, shared receptivity of involved individuals to an intervention, and the extent to which use of that intervention will be rewarded, supported, and expected within their organization			
Tension for change	The degree to which stakeholders perceive the current situation as intolerable or needing change	NR	+The Friendship Bench is the outcome of 20 years of community research on making mental health care more accessible at the population level	NR
Compatibility	The degree of tangible fit between meaning and values attached to the intervention by involved individuals, how those align with individuals' own norms, values, and perceived risks and needs, and how the intervention fits with existing workflows and systems	<p>+Motorcycles were used primarily as there was already an existing network of government-run fleet of motorcycles that were used for rural health outreach</p> <p>+Motorcycles were also most conducive for difficult terrains and are low cost to buy and maintain</p> <p>-Motorcycle use not maximized as 1 motorcycle was assigned to 1 health worker, whom being highly skilled did not dedicated sufficient time to rural outreach; missed opportunity to grant motorcycle access to community health workers who specialize in outreach activities</p>	<p>+Cultural adaptation of intervention by leveraging an existing network of elderly women "grandmothers" trained as lay health workers (LHWs) who were culturally mature and more trusted by their communities</p> <p>+Use of Shona Symptom Questionnaire (SSQ-14), a locally validated screening tool for common mental disorders</p> <p>+Using problem-solving therapy as a lower resource option in the LMIC context for addressing common mental disorders as it does not need extensive training or complex skills</p> <p>+Intervention was developed to be delivered using the available resources in this Zimbabwean health setting</p>	<p>+Leveraged the increasing use of mobile phones in the country to use an SMS component for monitoring voucher claims and paying franchisees and for delivery e-Vouchers</p> <p>+Youth-friendly training of community health educators (CHEs) and social franchisees, adapted from Madagascar's Ministry of Health's youth strategy</p> <p>+Adapted MSM to include a paper-based voucher component for participants who did not have mobile phones or were located in remote parts of the country with limited mobile network coverage</p> <p>+Provision of same-place, same-time redeeming, and provision of services to youth participants during sensitization activities in the community</p> <p>+Leveraged existing CHE and social franchisees networks within communities</p>

(Continued)

Table 3. (Continued)

CFIR CONSTRUCTS	DEFINITIONS	STUDY 1 (RIDERS FOR HEALTH-ZAMBIA)	STUDY 2 (FRIENDSHIP BENCH-ZIMBABWE)	STUDY 3 (YOUTH VOUCHERS-MARIE STOPES MADAGASCAR)
Relative priority	Individuals' shared perception of the importance of the implementation within the organization	NR	<ul style="list-style-type: none"> +Evidence of acceptability and feasibility of problem-solving therapy intervention by LHWs and community members from the pilot study +Integrating peer support meetings from intervention into routine clinic activities +Many participants were referred to Friendship Bench by clinicians and LHWs 	<ul style="list-style-type: none"> +Evidence of acceptability of mobile phone based voucher intervention and knowledge of and access to family planning services
Organizational incentives and rewards	Extrinsic incentives such as goal-sharing awards, performance reviews, promotions, and raises in salary, and less tangible incentives such as increased stature or respect	NR	NR	NR
Goals and feedback	The degree to which goals are clearly communicated, acted upon, and fed back to staff, and alignment of that feedback with goals	<ul style="list-style-type: none"> +Weekly surveys on healthcare worker productivity completed by healthcare workers using motorcycles +Supplementary survey of village respondents (at stud's midpoint) on health systems perceptions including how often they have observed health workers in their villages 	<ul style="list-style-type: none"> +A 6-item questionnaire was completed by LHWs to rate the intervention on topics like ease of learning about problem-solving therapy, ease of delivering the intervention, and perceived benefits to participants +Focus group discussion with LHWs about their implementation experience 	<ul style="list-style-type: none"> +Client and provider feedback from prior Marie Stopes youth voucher program in Zimbabwe informed MSM intervention (need to include services for sexually transmitted infection and follow-up visits for family planning) +Youth participants were attracted to same-place, same-time, redeeming of the voucher, and access to services within the community, during community mobilization events +Annual client exit interviews and mystery client visits to assess client experience
Learning climate	A climate in which: (a) leaders express their own fallibility and need for team members' assistance and input; (b) team members feel that they are essential, valued, and knowledgeable partners in the change process; (c) individuals feel psychologically safe to try new methods; and (d) there is sufficient time and space for reflective thinking and evaluation	NR	<ul style="list-style-type: none"> +Provision of a daily peer-support group for LHWs, besides routine weekly group supervision meetings 	<ul style="list-style-type: none"> +Quality monitoring of social franchisees by MSM +Annual internal and external clinical audits to evaluate the quality of client care and service provision +MSM continues to evolve based on client feedback and quarterly assessment reports
Readiness for implementation (sub-constructs are: leadership engagement, available resources, and access to knowledge and information)	Tangible and immediate indicators of organizational commitment to its decision to implement an intervention			

(Continued)

Table 3. (Continued)

CFIR CONSTRUCTS	DEFINITIONS	STUDY 1 (RIDERS FOR HEALTH-ZAMBIA)	STUDY 2 (FRIENDSHIP BENCH-ZIMBABWE)	STUDY 3 (YOUTH VOUCHERS-MARIE STOPES MADAGASCAR)
Leadership engagement	Commitment, involvement, and accountability of leaders and managers with the implementation	<ul style="list-style-type: none"> +Government health worker and transportation managers were contacted and surveyed +Partnerships with Ministry of Health and the Ministry of Community Development Mother and Child Health in Zambia +Zambian government motorcycles were included in experimental and control arms of Rider's intervention 	<ul style="list-style-type: none"> +Local Stakeholder and clinical professionals were engaged in the development and execution of intervention +City of Harare Health Department continued the Friendship Bench after its pilot, a show of support for the intervention at the health system level 	<ul style="list-style-type: none"> +MSM engaged and worked closely with leadership at the BlueStar franchisees (managers, coordinators, and health care providers)
Available resources	The level of resources dedicated for implementation and on-going operations, including money, training, education, physical space, and time	<ul style="list-style-type: none"> +Intervention provided driver training, fuel, preventive maintenance, and on-demand repair of motorcycles 	<ul style="list-style-type: none"> +Benches in discreet areas on clinic grounds were used by LHWs to assess and deliver the intervention +LHWs (9 d of training, using a manual) and their supervisors were trained 	<ul style="list-style-type: none"> +Training and accreditation of MSM social franchisees +Training of community health educators (CHEs) on the youth vouchers
Access to knowledge and information	Ease of access to digestible information and knowledge about the intervention and how to incorporate it into work tasks	<ul style="list-style-type: none"> +5-d training course and 1-d refresher course offered to health workers who operated the motorcycles 	<ul style="list-style-type: none"> +LHWs had access to detailed scripts in manuals to deliver the intervention +Use of an existing supervisory system, which included trained senior health promotion officers to supervise and support LHWs +LHWs reported being able to administer the intervention with ease 	<ul style="list-style-type: none"> +Provision of quality assurance monitoring and support for MSM BlueStar providers

Abbreviation: NR, not reported
 +Facilitator
 -Barrier

setting, either culturally as was observed in the training of LHWs and the use of the locally validated SSQ-14 for screening for common mental disorders in Zimbabwe. Similarly, interventions were tailored to recipients' conditions as was observed in youth-friendly training of community health educators (CHEs) and Blue Star social franchisees operators to counsel, refer and provide services to Madagascan youths redeeming vouchers. The singular contextual barrier identified in this appraisal—which falls under the Compatibility sub-construct, was that motorcycle use was not maximized in the Riders program in Zambia as there was a missed opportunity to grant motorcycle access to community health workers who specialized in and carried out more rural outreach activities than the crop of health workers who got the Riders motorcycles, but had competing health duties, besides rural outreaches to perform at clinic facilities. Channels for communicating goals and feedback on the implementation and intervention experience ranged from weekly productivity surveys of health workers and a mid-study supplementary survey of intervention recipients on service experience in the Riders program, to focus group discussions and questionnaires on implementation experience among LHWs in the Friendship Bench program. MSM used client and provider feedback from a similar Marie Stopes youth voucher program in Zimbabwe to enhance the intervention offered in Madagascar.

Among the 4 constructs under the Outer Setting CFIR domain, "Patient Needs and Resources" unanimously provided evidence of a recipient-centered approach to developing and implementing the interventions to cater to the pressing needs of recipients without depleting their already limited resources. In the case of MSM, the youth vouchers provided free sexual and reproductive health services to youth recipients. During the Friendship Bench pilot in Zimbabwe, financially distressed participants were encouraged to join local income-generating avenues (peanut butter making and recycling) being offered by the program. The entire premise of the Riders program in Zambia was to provide well-maintained motorcycle fleet to eliminate the barrier of transportation challenges to access health services for remote community dwellers.

An Exemplary Feasibility Assessment Profile for Resource Generation Interventions in LMICs—The Friendship Bench, Zimbabwe

Inadequate assessment of feasibility contributes to a suboptimal implementation of evidence-based interventions and subsequently undesired intervention outcomes. According to Bowen and colleagues, in order to guarantee feasible interventions, we should be asking three main questions about an intervention: (1) Can the intervention work?—a question asked at the initial intervention development phase; (2) Does the intervention work?—a question asked after some evidence has emerged that an intervention might work; (3) Will the intervention work?—a question asked after an intervention is proven to be efficacious

and effective and efforts are being made to translate the intervention into practice in diverse settings.²³

The Friendship Bench team investigated all three types of feasibility questions about task shifting to LHWs to provide psychosocial support and manage common mental health disorders. Assessing feasibility should also focus on the following aspects of an intervention: acceptability, demand, practicality, implementation, expansion, integration, adaptation, and limited efficacy testing. Depending on which of the 3 main questions being asked, each focus area has a particular set of outcomes, with different assessments. Some include focus groups, surveys, pre-post studies, quasi-experimental studies, cost-effectiveness analyses, and randomized controlled trials.²³

Of the three studies, The Friendship Bench research group closely adhered to Bowen's recommendations for assessing feasibility. There was detailed and deliberate reporting on the pre-implementation process and development of the intervention at different phases, that is, needs assessment of facilities and stakeholders (LHWs and clients), pilot and feasibility study, and effectiveness trial. The team conducted a rigorous and intentional assessment of the pre-implementation phases of this intervention, which started with a systematic review of psychological interventions for common mental disorders in LMICs, followed up with a pilot study (pre-post test study design),²² which doubled as a feasibility study of the intervention that would also inform on an intervention scale-up. In the pilot study, the intervention acceptability was evaluated.²² In order to develop the effectiveness trial, which also scaled up Friendship Bench from 3 to 12 clinics, the research team partnered with the Harare City Health Department, conducted a needs assessment of their clinics, and a competency assessment of the 300 LHWs of the health department.¹⁸ There were also series of focus group discussions and in-depth interviews with LHWs and clients for insight into the delivery and reception of this intervention. These pre-implementation and intervention development activities informed the adaptation of the intervention for the effectiveness trial.

The problem-solving therapy (PST) intervention underwent cultural validity and adaptation and used contextually relevant health workers cadre, which made it fitting for the Zimbabwean community setting.^{18,22} They also integrated supportive intervention components, which included providing supervision and support via voice calls and SMS messages using mobile devices and an income-generating activity such as peanut butter manufacturing, and crocheting bags from recycled plastic materials.^{18,22}

This holistic approach to the implementation and reiterative development and cultural adaptation of the intervention contributed to the feasibility of the intervention in the Zimbabwean context. With these processes, the research team was able to assess and ensure acceptability, adoption, and appropriateness of the intervention—all three qualities cumulatively increasing the feasibility of the intervention.

As demonstrated in the three case studies appraised, context inevitably plays a significant role in executing feasible resource-generating health interventions in LMICs. Evaluating and identifying contextual factors that influence the feasibility of EBPs should be a top priority for researchers and implementers of resource-generating interventions in LMICs. Central to the analysis of the role and influence of context on the feasibility of these interventions is capturing key actors' (individual researchers/experts/implementers) perceptions, lessons learned and recall of the implementation process, and how these observations and experiences shape the implementation process.²⁴ Within implementation science discourse, there is yet to be a situationally tailored and validated toolkit that researchers and implementers of interventions in LMICs can use to identify and capture the degree of influence of contextual factors on the feasibility of interventions in resource-constrained settings.

Conclusion

LMICs experience higher morbidity and mortality, compared to their resource-rich counterparts because of chronic resource deficits in tackling health issues. Implementation science provides researchers with evidence-based strategies to develop sustainable interventions with the potential to generate resources to facilitate the implementation of public health strategies, in resource-constrained settings such as LMICs. We searched the literature and found three noteworthy examples that provided the basis for a case-studies review of resource-generating interventions from Zambia, Zimbabwe, and Madagascar. This commentary advances the discourse on utilizing implementation science frameworks to evaluate the planning, execution, successes, and contextual facilitators and barriers of these types of interventions in low-resource settings. The critical appraisal of these studies demonstrates that contextual factors including—leadership and stakeholder engagement, building local capacity by training existing networks of health workers, cultural and contextual adaptations of interventions, supportive supervisory networks, optimizing routine client, provider, and implementer feedback channels to improve intervention, presence of capacity for research implementation, and infrastructure to support implementing and potential scaling of EBPs at local, regional or national levels are essential for feasible resource generation and maximization for public health interventions in LMICs. Furthermore, an exemplary assessment of intervention feasibility should include detailed and deliberate reporting on the pre-implementation process and development of the intervention at different phases, that is, needs assessment of facilities and stakeholders, pilot and feasibility study, and effectiveness trial, as observed in the Friendship Bench intervention. There remains a gap in the literature about tailored and validated tools and measures for assessing feasibility and the degree of contextual influence on the feasibility of interventions in resource-constrained settings. Nonetheless, the pillars of implementation science as espoused by the prominent determinant framework—CFIR can provide a roadmap for conceptualizing and executing novel,

contextually relevant interventions and programs to generate and maximize resources in LMICs to address vexing health problems.

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Author Contributions

TO, LK and EP conceived the idea of this perspective piece. TO, LK, BB and SE developed the manuscript by sourcing for information in published literature and synthesizing data from the case studies, discussed in the manuscript. EP, JG and NR provided critical feedback on the tone and content of the manuscript. All authors contributed to the editing of the manuscript.

Availability of Data and Materials

No data was collected in writing this manuscript. No other form of underlying research materials was used in this manuscript outside of the results reported in the published papers that were central to our manuscript.

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Supplemental Material

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