

**Multimodal Implementation Research on Primary Health Care Services in sub-Saharan Africa:
Implementation Outcomes, Service Readiness and Costs**

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ABSTRACT

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Primary health Care (PHC) serves as the cornerstone for achieving universal health coverage (UHC), one of the health-related targets in the 2030 Sustainable Development Goals (SDGs). PHC facility managers play a key role in ensuring quality of care by overseeing daily operations, managing human resources, and effectively implementing national PHC guidelines. This dissertation reports findings on implementation outcomes, service readiness, and costs through multimodal implementation research on strategies to improve PHC services in sub-Saharan Africa (sSA). Two of the three research Aims (Aims 2 and 3) are embedded within a district-based implementation and dissemination program in central Mozambique's PHC settings, called the Integrated District Evidence-to-Action (IDEAs) program for neonatal mortality reduction, implemented from 2016 to 2020. IDEAs applied a system-level Audit and Feedback (A&F) strategy that included three core components: routine facility and district readiness assessments, district-level biannual health facility performance review meetings, and targeted facility

support through supportive supervision to help health facilities implement their micro-interventions developed during the biannual meetings. There were nine cycles of IDEAs.

For Aim 1, this study synthesized implementation strategies and outcomes of evidence-based management interventions for PHC managers in sSA through a systematic review. Nine case studies from six countries—Ethiopia (3 studies), South Africa (2), and one each from Botswana, Kenya, Tanzania, and Zambia—were identified. The interventions included evidence-based training programs, peer-to-peer learning, electronic systems for monitoring management practices, and supportive supervision. Common implementation strategies included training and education, coaching and mentoring, knowledge sharing through learning collaboratives, interactive and continuous learning, and A&F using routine data. Interventions were implemented using more than one strategy. Acceptability was a consistent positive implementation outcome reported, with management effectiveness improving in areas such as financial and resource management, organizational climate, and human resource management.

For Aim 2, we assessed effectiveness of management training and IDEAs intervention on improving basic obstetric and neonatal service readiness in PHC facilities. We found that IDEAs intervention's effectiveness in enhancing service availability was highest when health facility managers in the intervention sites had received management training, with an average increase of 11.1 points out of 100 per year (95% CI: 0.7 to 21.5, $p=0.037$), after adjusting for potential confounders. Hence, capacitated PHC managers were better able to optimize a system-level A&F strategy to improve PHC services, bundling management training with A&F strategies could enhance effectiveness.

For Aim 3, a mixed costing approach (gross and microcosting) was used to estimate the cost of implementing IDEAs. We found the total cost of the program across 12 districts over five years (2016-2020), discounted to 2020 US dollars was USD \$2,197,971 with \$495,323 (23.8%) allocated to capital costs and \$1,702,648 (77%) to recurrent costs. The average cost of IDEAs activities annually per district was \$36,693; A&F meetings made up \$10,893 (29.7%) of costs, with per diem as the main cost driver; Capital cost were \$8,255 (22.5%), with vehicle purchase as the main cost driver; Targeted support were divided into two parts, district focused and facility supervision. The performance review meetings occurred biannually, each lasting five days, resulting in a total of 10 days per year per district. The average hours

spent per year attending A&F meetings for the seven key positions from health facilities, district and province was 2320 hours (80 hours per person annually per district), while five district staff conducting supervision spent a total of 240 hours per year (60 hours per person annually per district). We were not able to estimate staff hours for routine data collection since it was contracted to local agencies. This study provides new insights into the cost of implementing iterative system-level A&F strategies in low-income settings.

As demonstrated in this dissertation, we applied a multimodal implementation research approach — using evidence synthesis to improve health system coordination and management, strengthen management capacity, and incorporate economic evaluation — helped identify pathways for the systematic integration of national PHC guidelines, offering insights for improving PHC services. The key takeaway is that while implementation research is valuable for improving healthcare systems, there is a significant knowledge gap regarding what works for PHC management in sub-Saharan Africa and the costs associated with implementing a system-level A&F strategy. This dissertation aims to spread knowledge about strengthening health systems to improve primary healthcare and achieve universal health coverage.

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DEDICATION

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CHAPTER 1. INTRODUCTION

1.1 BACKGROUND

Primary health care (PHC) serves as the foundation of health systems, providing comprehensive and accessible services that include essential maternal and child health care (1). PHC functions as the critical entry point to healthcare services(2), particularly in sub-Saharan African countries (sSAs), where frontline health facility staff and managers deliver essential care (3,4). Primary health care serves as the cornerstone for achieving universal health coverage (UHC) targets outlined in the 2030 Sustainable Development Goals (SDGs), with success depending on healthcare workers' ability to deliver quality, people-centered integrated care effectively and efficiently(5). In a 2016 study, the World Health Organization (WHO) report estimated that expanding PHC initiatives in low and middle-income countries (LMICs) could potentially save 60 million lives and increase average life expectancy by 3.7 years by 2030 (6). Primary care facility managers hold an important role in managing the delivery of these services in PHC, contributing to the realization of UHC and the reduction of preventable maternal and neonatal deaths (7).

Health facility managers act as catalysts for quality service delivery through adequate support and supervision, playing a central role in ensuring service readiness—the capacity of health facilities to deliver basic services—which directly impacts healthcare delivery and health outcomes (8). However, there is a gap regarding the implementation of evidence-based management interventions and their impact on primary care service delivery and health outcomes in sSA settings. Though such interventions are rarely reported, there are studies that could provide insight if they are systematically reviewed and presented for researchers, implementers, and policy makers. While implementation strategies like Audit and Feedback (A&F) are widely used, there is limited understanding of how these strategies interact with primary care manager capacity and training interventions to improve service readiness.

Beyond understating the effect of strategies and primary care managers, in line with similar limited knowledge in implementation science and global health – is the limited information on the costing of effective implementation strategies that have been shown to improve the uptake of primary care services. Such information could be useful for managers at different levels of a health system to make informed decisions in relation to their existing or planned resources. Although costing and economic

evaluations are increasingly conducted in implementation research, there is a lack of data on the financial and economic costs of implementing a system-level strategy targeting maternal and child health program in LMICs (9–11).

Two of the three research aims in this study are embedded within the evaluation of a district-based dissemination and implementation program called the Integrated District Evidence-to-Actions (IDEAs) program for Neonatal Mortality Reduction in Central Mozambique (12). Though reports show high rate of primary health care (PHC) service coverage and utilization in Mozambique, maternal and neonatal mortality remains to be one of the highest in the region. To address this paradox, IDEAs program was designed to strengthen quality of service delivery by applying a system-level A&F strategy targeting system-level performance to optimize the implementation of existing Ministry of Health's PHC policies and programs.

The IDEAs program aimed to improve the delivery of evidence-based Maternal, Newborn, and Child Health (MNCH) programs across districts and health facilities by addressing key gaps in Mozambique's health system through the application of a system-level A&F strategy that involves MCH managers at facility, district, and province levels to review health facility performance and develop solutions that address identified gaps; and supports ongoing district-to-facility action implementation through a supportive supervision and provision of flexible funding to support implementation of these identified solutions (*micro-interventions*, defined as solutions selected, implemented, or adapted at the health facility level, not requiring significant financial resources).

This dissertation reports findings on implementation outcomes, service readiness, and costs through multimodal implementation research on strategies to improve PHC services in sub-Saharan Africa (sSA). The first aim in this dissertation synthesized implementation strategies and outcomes of evidence-based management interventions for PHC managers in sSA through a systematic review (Chapter 2). Then, guided by the Theory of Middle Managers' Role in Healthcare Evidence-Based Practice, we evaluated whether formal management training for primary care managers combined with IDEAs program improves on basic obstetric and neonatal service readiness (Chapter 3). Third, we described the cost of implementing the IDEAs program to enhance the uptake of national MCH guidelines in Mozambique (Chapter 4). Below are brief overviews of these chapters (Chapter 2-4)

Chapter Two of this dissertation applies implementation science frameworks to identify the types of interventions implemented and the strategies used to implement them in specific settings. We then assess the effectiveness of these interventions in terms of both implementation success and their impact on management effectiveness, and report how these studies measured management effectiveness. This information will be a resource to equip decision-makers, policymakers, and primary care managers with evidence to strengthen PHC management in SSA.

In Chapter Three, to address gaps related to understanding how management training interacts with other implementation strategies, our aim is to first examine the individual effects of the IDEAs intervention and formal management training on basic obstetric and neonatal service availability in Mozambique. Then, guided by the Theory of Middle Managers' Role in Healthcare Evidence-Based Practice, we evaluate whether formal management training for primary care managers enhances the effect of the IDEAs intervention in improving maternal and child health service availability. The IDEAs study used the World Bank's Health Service Delivery Indicator (SDI) survey (particularly, the Portuguese version applied in Mozambique in 2014) to evaluate management effectiveness associated with the intervention. Together, the SDI survey intends to describe provider abilities, provider activities, and the availability of resources for effective management in healthcare delivery.

In Chapter Four, we address the fact that though there are growing applications of economic evaluation in implementation research, little research has been conducted assessing details about the costs associated with implementing new interventions or adapting existing ones. It also happens that most implementation science studies applying economic evaluation are from high-income countries, where resource constraints are relatively relaxed compared to cash-strapped health systems in LMICs. Economic evaluations are important tools for decision-makers to choose between the status quo and alternative strategies in implementing evidence-based practices. Yet, there is little guidance on how to measure costs associated with adopting effective implementation strategies. So, there is still a need to understand the cost of implementation strategies that aim to improve patient care and population outcomes.

This dissertation attempts to provide insights into effective strategies for enhancing PHC management capacity to implement PHC guidelines for quality service. It also evaluates the combined

impact of management training and a system-level A&F strategy on PHC program service readiness. By doing so, this dissertation contributes to the field of implementation science in global health, offering valuable information on combining management capacity-building strategies with a system-level A&F approach to improve PHC service readiness—an area with limited existing knowledge. Additionally, it demonstrates how to estimate the cost of implementing a system-level A&F strategy in sSA, providing insights for scaling the IDEAs program in similar contexts.

CHAPTER 2. IMPLEMENTATION STRATEGIES FOR EVIDENCE-BASED MANAGEMENT
INTERVENTIONS AMONG PRIMARY HEALTH CARE MANAGERS IN SUB-SAHARAN AFRICA: A
SYSTEMATIC REVIEW

2.1 ABSTRACT

Background

Primary care facility managers play a key role in ensuring the quality of primary care delivery by managing daily operations, human resources, and effectively implementing national Primary health care (PHC) guidelines. We conducted a systematic literature review to identify and synthesize implementation of evidence-based management interventions for PHC settings in Sub-Saharan Africa (SSA), including implementation strategies, outcomes and management effectiveness.

Methods

We performed a comprehensive search on the concepts of primary health care, managers, interventions, strategies, outcomes (skill/capacity) and SSA across nine electronic bibliographic databases, published from 2012-22. We included the characterization of key intervention components and mapped implementation strategies based on the nine Expert Recommendations for Implementing Change strategy thematic areas and Proctor's Implementation outcome framework to create consistent definition and language. Our analysis approach involved a narrative review and thematic analysis.

Results

We identified 3,752 studies, of which nine were included after abstract and full-text screening. These nine case studies spanned six sub-Saharan African countries. From these studies, we identified four key intervention categories: training and capacity building through training manuals or programs, peer-to-peer learning, an integrated system using A&F of management practices, and supportive supervision. Delivery strategies for these interventions included training and education, coaching and mentoring, knowledge sharing through learning collaboratives, interactive and continuous learning, and A&F strategy using routine data. Interventions were implemented using more than one strategy. Acceptability emerged as a consistent outcome observed across all studies. Key areas of management effectiveness highlighted in the review include improvements in financial management, organizational climate and culture, resource

management and utilization, and human resource management. Five studies reported intermediate health outcomes, including improved maternal and child health indicators associated with better management.

Conclusion

In summary, the interventions primarily focused on skill-building, collaboration, and ongoing support, with two or more strategies used together. However, there is limited information on the effectiveness of these strategies individually or in combination. More reports are needed on effective interventions for PHC managers in SSA and their implementation. Implementation research can help accelerate the uptake and integration of effective intervention to improve PHC management.

2.2 BACKGROUND

Strong primary healthcare (PHC) is essential for achieving the health-related Sustainable Development Goals (SDGs) by 2030, which aim to end preventable child and maternal deaths, control epidemics, and promote mental well-being for all [(13)]. Universal health coverage (UHC) is a key SDG target that highlights the need for everyone to have access to necessary health services without financial hardship [(14)]. A robust PHC system is essential for achieving this goal, as 90% of the essential health services required for UHC can be provided through it [(15),(4,16,17)]. Despite Sub-Saharan African (SSA) countries' efforts to expand government-run primary healthcare (PHC) services for better coverage, studies highlight quality issues due to poor service delivery [(18,19)]. Primary care managers are key actors in ensuring quality primary care by managing daily operations and implementing national PHC guidelines effectively [(20)].

Primary care facility managers face a complex mix of challenges that prevent effective service delivery. Some of these challenges include weak infrastructure, limited human resources, and shortage of medical supplies [(21,22)]. On the other hand, a lack of management skills can also contribute to these weaknesses. Healthcare workers often lack adequate training and support when they are promoted to managerial roles, further hampering the development of strong health care systems [(23–26)]. This lack of focus on management capacity and effectiveness is further underscored by the limited efforts to measure and improve management effectiveness in SSA [(27–30)].

Despite available tools and evidence from both high-income countries (HICs) and some emerging examples in SSA, there remains a significant gap in establishing consistent and generalizable tools for measuring and evidence for strategies to strengthen management effectiveness in SSA designed to improve PHC delivery. It is worth noting that there is no established core set of indicators to measure leadership and management in global health, particularly in PHC management [(29,31)]. For instance, among the 100 core WHO health indicators listed, which include a domain on governance, only one indicator on leadership and management is included in this domain – the existence of a national health sector policy, strategy or plan, with no additional information on health facility management. [(31)].

The lack of standardized measurement for management practice and effectiveness in SSA creates a significant gap in improving quality of primary care delivery. Implementation science, a field focused on studying methods to improve the uptake of evidence-based practices into routine healthcare settings, could be used to bridge this gap [(32,33)]. Implementation science provides tools for strengthening the development, description, and evaluation of interventions and implementation strategies specifically designed to improve PHC management in SSA.

We conducted a systematic literature review to identify and synthesize implementation of evidence-based management interventions for PHC settings in Sub-Saharan Africa (SSA), including implementation strategies, outcomes and management effectiveness. This information will be a resource to equip decision-makers, policymakers, and primary care managers with evidence to strengthen PHC management in SSA. We employed implementation science frameworks to identify the types of interventions implemented and the strategies used to implement them in specific settings. We then assessed the effectiveness of these interventions in terms of both implementation success and their impact on management effectiveness. and reported how these studies measured management effectiveness.

2.3 METHODS

We registered the systematic review protocol in the International Prospective Register of Systematic Reviews (PROSPERO # CRD42023445520) and followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines presented in Figure 1 [(34)]. Please refer to PRISMA checklist included in the Additional file 1: Table A

Search Strategy

We searched the following databases: PubMed, Embase (Elsevier), Global Index Medicus, CINAHL (EBSCO), Web of Science Core Collection (SCI-Expanded, SSCI, A&HCI, ESCI), Cochrane Library (Wiley), WHO Institutional Repository for Information Sharing – IRIS, SciELO Citation Index (Clarivate),

and African Journals Online. The search focused on for the period 1 January 2012– 31 December 2022, covering 10 years. The search strategy focused on the concepts: primary health care, interventions, strategies, leaders/managers, management effectiveness outcome (skills/capacities gained) and SSA (see Additional file 2).

Inclusion and Exclusion Criteria

We established criteria for the selection of studies, prioritizing peer-reviewed articles and grey literature that contribute insights into efforts to strengthen primary healthcare management in SSA. We included articles with a specific emphasis on evaluating the effectiveness of initiatives aimed at improving primary healthcare management. A table detailing inclusion and exclusion criteria is available in Additional file 1: Table B

Study Selection and Data Extraction

Our team used Covidence [(35)] to conduct a two-stage (initial screening and full text screening) using a double-blind screening process. Studies with clearly defined interventions and strategies for improving management effectiveness in SSA PHC settings moved on to full-text review. Weekly team meetings were held to monitor progress and address outstanding review issues. Two reviewers independently extracted information from each article, with a third reviewer solely resolving any conflicts.

Data Synthesis

Our analysis involved a narrative review, thematic analysis, and examination of trends across the studies. We extracted types of intervention, implementation strategies, and any identified effectiveness or implementation outcomes. Initially, we categorized strategies used by the studies to identify common themes, and then mapped the reported strategies within the thematic areas of the Expert Recommendations for Implementing Change (ERIC) strategy framework thematic areas [(36,37)] and reported implementation outcomes using Proctor's implementation outcome framework [(38)]. We identified management effectiveness measures using a thematic analysis approach.

Quality Assessment

To assess the quality of the chosen study, we employed the Joanna Briggs Institute (JBI) critical appraisal checklist, adapting it to our research question as needed [(39)]. Due to the limited number of articles, exclusions from studies based on quality assessment were not conducted. However, the outcomes of our quality assessment were reported.

2.4 RESULTS

The search strategy yielded 3752 studies, among these, 1568 were duplicates. We screened the title and abstract for the remaining 2184, studies with 38 chosen for full-text review. Among the 38 included for full-text review, 9 (24%) were included for data extraction, with 29 (76%) studies excluded because 17 (44%) did not report an intervention or strategy, 5 (13%) reported outcomes unrelated or no outcomes in management effectiveness 6 (16%), had wrong population and 1(3%) unavailability of full text document.

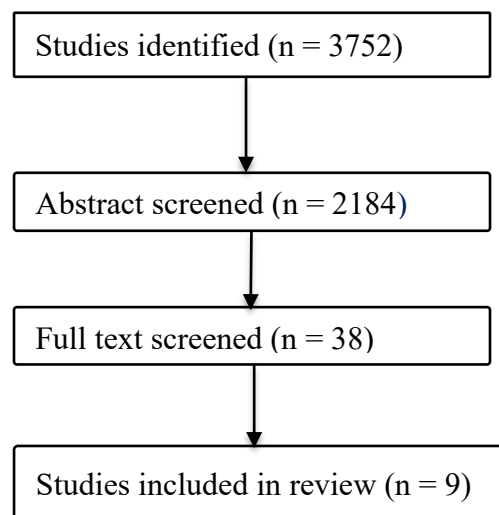


Fig 1. PRISMA flowchart of study selection

Overview of selected studies

The nine case studies represented six Sub-Saharan African countries, with three from Ethiopia [(40–42)], two from South Africa [(30,43)], and one each from Botswana [(44)], Kenya [(45)], Tanzania [(46)], and Zambia [(47)]. The funding for these studies primarily came from institutions such as USAID, The Atlantic

Philanthropies, Johnson and Johnson, International Development Research Centre, The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Europe Aid, and Irish Aid. Sample sizes varied based on the target population and study setting; for example, a study in Ethiopia covered 284 districts from different regions with multiple facilities [(42)], while another in Kenya included only ten facilities from the same region [(45)]. The study durations ranged from 11 months to four years, with five studies conducted within a one-year or shorter time frame. The interventions to improve management effectiveness differed in duration and structure, a one-year certificate program featuring mobile health communication platforms in Zambia [38], and multi-year action learning cycles in South Africa [34]. Four studies used a quantitative-only approach, while three had a mixed-method design, and two were qualitative studies. Various study designs, including prospective cohort studies, cross-sectional designs, longitudinal/quasi-experimental approaches, and a cluster randomized controlled trial, were employed. Interventions targeted multiple levels of health systems, including facility, sub-district, or district levels. They also focused on specific populations of facility managers, unit managers, and district health managers leading PHC facilities or district teams. An overview of the studies included is provided in Additional file 3: Table A.

Overview of Interventions for Enhancing Management Effectiveness or Competency

The interventions in the studies can be broadly categorized into four main types: Training and capacity building programs [(40–42,47)], Peer-to-peer learning [(23,44)], Integrated system using A&F of management practices [(45)], and Supportive supervision [(46)] (Table 1). The development of these interventions varied across contexts. For example, in Zambia, a formative assessment conducted by a national university informed intervention development, implemented in partnership with development partners at the request of the Ministry of Health [38]. In Kenya, interventions were derived from the national strategy on the quality model for quality management and an integrated primary health care quality measurement electronic application from Germany, adapted with support from foreign development partners and the Kenyan Ministry of Health's Department of Standards and Regulatory Services [36]. In South Africa, the two included studies were part of a collaborative project involving health managers, researchers, and local health sector policymakers through service-research

partnerships and participatory intervention design efforts [19,34]. In Ethiopia, three studies utilized the same intervention -- a locally adopted version of the USAID's In-service leadership, management, and governance syllabus for training health professionals to master practices and competencies for managers and governance developed in 2016, with variations in the target group and level of the health system represented. These interventions involved leadership development manuals with in-service training for healthcare managers using training guidelines developed by the Federal Ministry of Health and development partners [31–33]. Some interventions were specifically designed to target management effectiveness through capacity building, while others integrated management capacity and quality of care interventions.

Table 1: Overview of interventions and examples of interventions aimed at management capacity.

Intervention Domains	Specific Interventions
Training and Capacity Building using an evidence-based training manual or program	Locally adopted version of USAID's leadership, management, and governance manual [(40–42)]
	Competency-based blended learning program for leadership and management practice (CLMP) [(47)]
Peer-to-peer learning	A collaborative action learning approach that includes reflective practice and formation of communicative space [(43)]
	Cycles of collaborative action and learning, a service-research partnership focused on addressing governance issues [(30)]
	Participatory action research that involves a cyclic process of planning, action, observation, and reflection [(44)]
Integrated system using audit and feedback of management practices	Adapted Integrated Quality Management System which incorporates a multi-perspective, multifaceted and repeated indicator and electronic based assessment [(45)]
Supportive supervision	Support, Train and Empower Managers (STEM) intervention through technical support for supportive supervision [(46)]

Overview of Implementation Strategies for Delivering Interventions

Thematically, strategies used in these studies fall into six key areas: Training and Education, Coaching and Mentoring, Knowledge sharing through learning collaborative, Interactive and continuous learning,

and A&F using routine data. Within each domain, there are specific strategies implemented by the studies that we grouped together (Table 2).

Table 2: Overview of Implementation Strategies domain areas and specific strategies identified by the studies

Implementation strategy domains [(36)]	Specific strategies implemented by the studies
Training and Education	Six-day classroom training sessions
	Training of trainers
	Didactic workshops through in-person trainings
	Interprofessional/cross-cadre training
Coaching and Mentoring	Onsite coaching and technical support to trainees using the observe, ask, listen, feedback and agree (OALFA) technique
	Supportive supervision
	Managers developing and implementing action learning sets in collaboration with coaches and mentors from sub district, district or national level public health governance.
Knowledge sharing through learning collaborative	Acquired knowledge sharing events (Learning Collaborative)
	Monthly joint calls for facilitated discussions
	Reflective discussions among managers themselves, or with regional authorities or community members,
	Use of mobile technology for learning group discussions
Interactive and continuous learning	Maternal and child health service improvement projects
	Performance improvement projects
	Leadership development support
	Cycles of activities (situational analysis, community profiling, etc.)
Audit and feedback using routine data	Validation of indicators
	Developing data collection tools
	Evaluative and iterative strategies
	Use of digital tools for quality management system
	In-depth interviews and discussions
	Participatory action research
	Reflection using reflectivity method

When the specific strategies mapped to the ERIC strategy thematic areas, we found a different set of strategy combinations bundled to implement an evidence-based intervention. For instance, *training and educating stakeholders* often coincided with using *evaluative and iterative strategies* and *providing interactive assistance*. Similarly, the *use of evaluative and iterative strategies* is frequently paired with *developing stakeholder interrelationships* and *adapting to context*. *Developing stakeholder interrelationships* commonly occurs alongside *using evaluative and iterative strategies*, *providing interactive assistance*, and *training and educating stakeholders*. *Providing interactive assistance* is often mentioned in conjunction with training and educating stakeholders and developing stakeholder interrelationships. Lastly, *engaging consumers* occasionally aligns with *adapting and tailoring to context* and *developing stakeholder interrelationships*. A detailed description of strategy mapping to the ERIC strategy thematic areas, as well as strategies per intervention area, frequency of strategies applied are included in Additional file 3: Table B, C, D & E

Reported Outcomes: Implementation and Effectiveness

Implementation outcomes

For implementation outcomes, acceptability emerged as a consistent outcome across all studies. In addition, six studies reported adaptation, appropriateness, and feasibility. Only one study reported scale-up of an intervention to a national level [(47)], with Ministry of Health adopting intervention and implementation strategies.

Management Effectiveness

The key domains of management effectiveness that emerged in the included studies are: improved financial management, enhanced organizational climate and culture, improved resource management and utilization, and Improved human resource management (Table 3). Improved financial management is demonstrated through increased health facility-level budget utilization and improved resource mobilization. Enhanced organizational climate and culture measured by favorable work climate scores and the development of a collaborative environment, promoting communication, ownership, motivation, innovation, and problem-solving capacity. Improved resource management and utilization facilitated

through enhanced data quality, strategic planning, and overall improvement in information utilization culture. Improved human resource management are highlighted through reported staff willingness to work together and engage in on-the-job training among facility managers.

Table 3: Management Effectiveness Outcomes

Management effectiveness domains	Studies and what they measured
Improved Financial Management	Increased health facility-level budget utilization [(41)]
	Improvement in resource mobilization and use [(42)]
Enhanced Organizational Climate and Culture	Favorable work climate scores [(40)]
	Collaborative working environment, improved communication, staff ownership, motivation, innovation, and enhanced problem-solving capacity [(41)]
Resource Management and Utilization	Improved data quality and use [(41)]
	Improvements in strategic planning, management of resources, and leadership[(47)]
	Overall improvement of management indicators, including supplies, drugs, data, amenities, and waiting times [(45)]
Improved human resource management	Staff reported willingness to work together and on-the-job training and peer support among facility managers [(23)]

Intermediate service-level and clinical outcomes

Five studies reported service-level and clinical outcomes associated with the interventions. In Ethiopia, Education and training, including workshops and coaching, using a training manual led to improvements in health indicators like institutional deliveries and ANC retention. Zambia's interactive and continuous learning program significantly increased HIV-exposed infant testing, ANC coverage, and immunization rates.

Improvements across several health service outcomes, including a two-fold increase in institutional deliveries, a 30-40% increase in antenatal care (ANC) retention, and a 4%-40% increase in family planning coverage. Service-level results showed a 39% increase in facility budget utilization, a 20% improvement in data quality, and a 92% implementation of WASH facilities, while community outcomes

included a 67% improvement in home-based HIV testing and counseling and a 30%-78% increase in complete referrals.

Contextual Factors Enhancing Implementation Strategy Uptake

The implementation strategies were facilitated by contextual factors characterized by stakeholder engagement from the outset, involving collaborative intervention design and solution prioritization with local policymakers, community leaders, and health facilities. Studies emphasized a step-by-step process, including adequate onboarding, workshops, and continuous learning as formal training methods, supplemented by targeted mentorship from existing district or provincial experts to improve health facility management. This participatory approach formed the basis for strengthening management effectiveness, with primary healthcare playing a central role in each country's health system, supported by health governing institutions.

Limitations recognized by the studies included a lack of baseline information, non-blinding of interventions to data collectors, the challenge of conclusively determining factors influencing improvement, absence of control groups in some studies, potential bias in supervisions made by project staff, and challenges in maintaining energy around local area groups. Several studies recommended long-term monitoring of intervention effects, emphasizing the need for sustained evaluation beyond the study's immediate timeframe. Additionally, economic evaluation information in included studies, including cost-related details, was absent in all studies.

Quality appraisal.

Utilizing the JBI-derived quality appraisal tool and following a two-person quality appraisal, the studies' quality percentages ranged from a low of 46% to a high of 100% on a 16-item quality appraisal questionnaire, where 100% means high quality (see Additional file 3: Table F).

2.5 DISCUSSION

This systematic review offers a nuanced understanding of various published interventions, targeted areas, strategies, methodological approaches, and outcomes aimed at improving primary healthcare management. We found that there are limited reports on the implementation of existing interventions to improve selected areas of primary healthcare management, with only nine studies available. These interventions primarily focused on building skills, promoting collaboration, and providing ongoing support. While multiple strategies were often used together, there is limited information on how effectively these strategies worked. The management effectiveness outcomes reported were mostly positive, but there is little information on what did not work. Few studies reported service or clinic-level outcomes, but those that did showed positive improvements overall.

As observed in Kenya and Zambia, the integration of electronic/digital or mHealth to improve knowledge sharing and knowledge attainment, in addition to the most common strategies used to improve management. A common feature among all the strategies were participatory and collaborative approaches that involved behavioral and management culture change among health managers. Interventions were implemented using more than one strategy.

We found variability in measurement tools used to capture implementation and effectiveness outcomes. In terms of tools to measure management effectiveness in LMICs' PHC settings, there is a need to standardize outcome measurement. While direct impact assessment on population health outcomes is limited, some studies reported improvements in service-level and clinic-level outcomes, particularly in maternal and child health indicators [(40,45,47)]. These findings suggest a positive association between management effectiveness with improved health outcomes. Management effectiveness domains identified in this review could be further tested in future management effectiveness evaluation efforts.

Limitations

Some limitations of this review include the possibility of missing interventions and strategies despite a thorough search, as our inclusion and exclusion criteria might not have captured all relevant programs and policies implemented in SSA settings. The definition of management in PHC needs further refinement to the reality on the ground with some universal effort establishing key PHC managers' role at the facility and district levels in SSA. Heterogeneity in methodology presents challenges in assessing management strength. Despite these limitations, consensus meetings with the team and information scientists were conducted to ensure comprehensive article inclusion during the database search. We included three studies from Ethiopia with similar interventions [(40–42)], but different strategies reported at different times and scope, considering them as separate studies based on group consensus.

Future Recommendations

Considering management as a core component of the health system's leadership and governance building block, we learned that there is a lack of studies showing interventions and strategies aimed at enhancing the capacity of primary health care managers. Therefore, there is a need for more reports on demonstrating effective interventions for PHC managers in SSA and their implementation outcome and how it affects service-level and clinical outcomes. Implementation research can help accelerate the uptake and integration of effective intervention to improve PHC management. Given the shortages of infrastructure, equipment, and necessities, studies will need to examine how these factors influence the quality of health facilities and health facility management. Future studies or policy consideration could apply interventions and strategies identified in this review to enhance primary health care management effectiveness through various engagement processes identified in this review.

Additionally, it is essential to clearly distinguish the role of PHC managers in different SSA settings through a broader landscape analysis to design specific tools and interventions for each [(29)]. We believe the distinction between the two concepts – leadership and management -- could be difficult to discern in some settings where PHC managers have authority to influence strategic planning and making fundamental changes in policies and guidelines. The studies emphasize the importance of validation, consistency, and addressing gaps such as the absence of control groups, potential bias, and challenges

in maintaining energy in local groups, especially when using participatory or co-creating designs. Implementing interventions with an implementation science approach, utilizing research frameworks, models, and theories, is necessary for a deeper understanding of implementation processes, outcomes, and effectiveness on health outcomes. Additionally, there is a need for better measures to understand what interventions specifically target in terms of management, aiming not only for improved management outcomes but also sustained improvements in population health.

2.6 CONCLUSION

This review shows there's new evidence and emphasizes the importance of consistently assessing how management affects health system delivery. Management, as a core component of the leadership and governance building block, intersects with the performance of other building blocks, playing an important role in enhancing the overall system's performance. This highlights the significance of evaluating and measuring management while identifying strategies that enhance its effectiveness. This study is critical to achieve the strengthening of the health systems needed to improve primary health care and achieve universal health coverage. It initiates a conversation about effective approaches to improve management in primary healthcare within SSAs, encouraging collaborative efforts to address gaps and enhance the study of these topics.

2.7 LIST OF ABBREVIATIONS

ERIC – Expert Recommendations for Implementing Change

LMIC – Low -and middle-income countries

PHC – Primary Health Care

PRISMA – Preferred Reporting Items for Systematic Reviews and Meta-Analyses

SSA – sub-Saharan African countries

WHO – World Health Organization

Declarations

Ethics Statement

Not applicable as the article is a systematic review

Consent for publication

Not Applicable

Availability of Data and Materials

All data generated or analyzed during this study are included in this published article [and in additional file 3].

Conflict of Interest

None declared.

Clinical trial number

Not applicable

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Authors' Contribution

EB conceived the study with guidance from LRH and KH. EB and SU collaborated with information scientists to formulate the search strategy and developed the review protocol, including the selection of risk of bias assessment tools. TJ executed the search string across various databases and imported eligible articles to Covidence. EB and SU conducted title and abstract screening, with AD resolving conflicts or disagreements. EB, AD, and ST conducted full-text screening with LRH and SU resolving conflicts. EB, SU, and ST conducted data extraction and held consensus meetings. EB synthesized and wrote the results with support of LRH. SG and B JW provided additional technical expertise in the study topic areas. All Authors reviewed the manuscript. EB, KS and LRH performed the final review, and EB led the submission process. All authors approved the final submission.

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2.8 LIST OF ADDITIONAL TABLES

Table A: PRISMA Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			Page
Title	1	Identify the report as a systematic review.	1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	NA
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	5-6
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	6
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	7
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	7
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	7 and Supplemental file 2
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	8
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	8
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	NA
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	NA
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked	8

Section and Topic	Item #	Checklist item	Location where item is reported
		independently, and if applicable, details of automation tools used in the process.	
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	NA
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	8
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	NA
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	8
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	8
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	NA
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	NA
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	8
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	NA
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	9
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	10-11
Study characteristics	17	Cite each included study and present its characteristics.	10-11
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	19
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	11-17 and supplemental file 3
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	19

Section and Topic	Item #	Checklist item	Location where item is reported
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	NA
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	NA
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	NA
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	NA
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	NA
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	19-20
	23b	Discuss any limitations of the evidence included in the review.	19
	23c	Discuss any limitations of the review processes used.	20
	23d	Discuss implications of the results for practice, policy, and future research.	10-11
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	7
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	7
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	NA
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	25
Competing interests	26	Declare any competing interests of review authors.	25
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	25

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71. doi:

Table B: Inclusion and exclusion criteria

	Inclusion Criteria	Exclusion Criteria
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Study types	• Quantitative • Qualitative • Mixed methods • Peer-reviewed journals • Studies focused on health sector • Published in English or French • Studies showing effectiveness	• Literature reviews • Commentary/perspectives • Studies focusing on non-health sector • Published in other languages except English and French • Discussions/or any study that does not show effectiveness.
Population	• Public Sector PHC health facility managers • District primary health care team with a supervisory/accompaniment role to health centers • Sub-Saharan Africa	• High-income countries PHC • Secondary level health facilities • Referral or regional hospitals managements (District, province or capital city)
Intervention	• Single interventions or strategies • Multifaceted/multicomponent package • Programs, practice, policies, products, principles, procedures	• Unstructured and informal one-off trainings with no evaluation assessments. • Survey tool validation
Comparison	• Facilities or districts that did not receive the intervention (Status quo) • Quasi-experimental design, with before and after time periods • Experimental designs • Qualitative assessment	• Leaders' recommendation for quality standards/performance indexes • Validation of management measures • Incomparable countries or health systems
Outcomes	• Management effectiveness (competency, skill, and quality) assessed through self-reported or assessed survey • Process quality/adherence to guidelines • Structural quality • Service readiness outcomes • Service delivery and systems outcomes	• One-time pre and post-test following a one-time training • Survey validation outcomes
Timeline	• Publications between 2012-2022	• Publications before 2012

Table A. Overview of selected studies

First Author and Year	Year Published	Level of Intervention	Country	Target Population	Sample Size	Implement or	Study Time Period	Study Design

Argaw, M.D., 2021	2021	District and Facility	Ethiopia	PHC Managers and Supervisors	544 (272 LMG, 272 Non-LMG)	USAID Transform: Primary Health Care project	Aug 28, 2017 - Sep 30, 2018	Quantitative with Repeated Cross-Sectional
Bayou, B., 2020	2020	Facility and Regional PHC Offices	Ethiopia	14 Primary Health Care Entities	Max 25 per facility (Total not specified)	John Snow, Inc. (JSI/SEUHP) in collaboration with FMOH, RHBs, and town/sub-city health offices	Nov 2016 - Aug 2017	Mixed-Methods Cohort
Cleary, S., 2018	2018	Facility and Sub-Districts	South Africa	Facility Managers, Sub-District Management Team, Facility Staff	Not specified	Research Team with Organizational Psychologist	2012 - 2016	Qualitative with Document Reviews, Interviews, Group Discussions, and Thematic Analysis
Desta, B.F., 2020	2020	District	Ethiopia	District Health Managers, Health Workers	284 Districts (94 LMG, 190 Non-LMG)	Pathfinder, PHC Transform	Jan - Dec 2019	Quantitative with Comparative Cross-Sectional
Foster, A.A., 2018	2018	Facility	Zambia	Nurses in Charge, Facility Heads, District Nurse Supervisors	20 Nurses and 5 Supervisors	Local Academic Institution and Project Partners	2016 - 2017	Single-Arm Cohort with Mixed Methods
Gilson, L., 2014	2014	Subdistrict	South Africa	Facility Managers	Not specified	Researchers in collaboration with Subdistrict Health Managers	2010 - 2013	Qualitative: Observations, Interviews, Focus Group

								Discussions
Marx, M., 2018	2018	Facilities	Kenya	Health Facility Leadership	Ten Facilities	Kenyan Ministry of Health - Department of Standards and Regulations	2013 - 2016	Longitudinal Quantitative
Nkomazana, O., 2016	2016	District	Botswana	District Health Managers	12 District Managers	Research Team with Organizational Psychologist	Mar 2013 - Mar 2014	Cross-Sectional
Uduma, O., 2017	2017	Facility	Tanzania	Health Facility Supervisors, District Managers	45 Facilities	Ministry of Health, Foreign Agency, Research Teams	May 2012 - Apr 2014	Randomized Experimental Design with Mixed Methods

Table B. Overview of Interventions and Strategies

Author	Intervention/innovation	Target Group	Delivery/Implementation Strategies Chosen	Strategy Mapping to Thematic Areas
Argaw, M.D., 2021	Locally (by Federal Ministry of Health) adopted version of the USAID's In-service leadership, managements and governance syllabus for training health professionals to master practices and competencies for managers and govern developed in 2016.	Volunteering Health workers from randomly selected primary health care facilities providing maternal and child health services in the four regions of Ethiopia	1.Six-day classroom training sessions using the training course material followed by maternal and child health service improvement projects 2. Four onsite coaching using the observe, ask, listen, feedback and agree (OALFA) technique 3. Acquired knowledge sharing events (Learning Collaborative)	1. Train and educate stakeholders. 2. Use evaluative and iterative strategies. 3. Develop stakeholder interrelationships . 4. Provide interactive assistance.

Bayou, B., 2020	Locally (by Federal Ministry of Health) adopted version of the USAID's In-service leadership, managements and governance syllabus for training health professionals to master practices and competencies for managers and govern developed in 2016.	Head of health facility and representative s from all service delivery units of a health facility including outpatient department; maternal, neonatal and child health services	1. Training of trainers 2. Three, Two- or three-day didactic workshop 3. Workplace assignment for interactive and continuous learning 4. Final workshop for improvement plan result dissemination	1. Train and educate stakeholders. 2. Use evaluative and iterative strategies. 3. Develop stakeholder interrelationships (learning collaborative). 4. Provide interactive assistance. 5. Adapt and tailor to context.
Cleary, S., 2018	A collaborative action learning approach that includes reflective practice and formation of communicative space. Framed within the ten components of the <i>Thinking Environment</i> principles related to health system governance, relationships and values.	Sub district health manager, sub district PHC manger,	1. In-dept interviews and discussions 2. Reflective discussion 3. Evaluative and iterative strategies	1. Engage consumers; 2. Evaluative & iterative strategies; 3. Adapt & tailor; 4. Develop stakeholder interrelationships ; 5. Interactive assistance; 6. Train & educate stakeholders
Desta, B.F., 2020	Locally (by Federal Ministry of Health) adopted version of the USAID's In-service leadership, managements and governance syllabus for training health professionals to master practices and competencies for managers and govern developed in 2016.	District Health Managers responsible for provision of primary health care	1. Team based In-service trainings consisting of two to three people from each district, 2. Planning and implementation of performance improvement projects, 3. Onsite coaching and technical support to trainees using the observe, ask, listen, feedback and agree (OALFA) technique	1. Evaluative & iterative strategies; 2. Develop stakeholder Interrelationships; 4. Support clinicians; 5. Interactive assistance; 6. Train & educate stakeholders

Foster, A.A., 2018	A competency-based, blended learning program for a certificate in leadership and management practice (CLMP)	Nurses in Charge, Facility Heads, District Nurse Supervisors	1. Interprofessional/cross-cadre training 2. In-person trainings with peer-to-peer learning 3. Monthly joint calls for facilitated discussions 4. Monthly reviews of workbook exercises keep nurse managers involved in the coursework 5. Supportive supervision 6. Use of mobile technology to participate in mobile based learning group discussions 7. Use of Mobile application to supplement workbook reading and cross-cadre activities	1. Engage consumers; 2. Evaluative & iterative strategies; 3. Change infrastructure; 4. Adapt & tailor; 5. Develop stakeholder interrelationships ; 6. Support clinicians; 7. Interactive assistance; 8. Train & educate stakeholders
Gilson, L., 2014	District Innovation and Action Learning for Health Systems Development (DIALHS) cycles of collaborative action and learning, a service-research partnership focused on addressing governance issues	Facility Managers	Cycles of 1. Situational analysis, 2. community profiling to role model population orientation 3. Documenting PHC facility managers role 4. Community profiling follow-up 5. Group coaching support for PHC facility managers 6. Information and knowledge use by PHC facilities 7. Leadership development support	1. Engage consumers; 2. Evaluative & iterative strategies; 3. Adapt & tailor; 4. Develop stakeholder interrelationships ; 5. Train & educate stakeholders
Marx, M., 2018	Adapted Integrated Quality Management System which incorporates a multi-perspective, multifaceted and repeated indicator based assessment, covering the 6 World Health Organization (WHO) building blocks using software that allows feedback to facility staff, benchmarking and	Health Facility Leadership	1. Validate indicators adapted to Kenya setting through local relevant guidelines, policy and planning documents, standards scientific literature 2. Use of expert panel to review adapted and validated indicators using Delphi method 3. Developing data collection tools based on the finalized indicators 4. Use of digital tool to integrate and roll out	1. Engage consumers; 2. Evaluative & iterative strategies; 3. Adapt & tailor; 4. Support clinicians; 5. Interactive assistance

	facilitates improvement plans		integrated quality management system	
Nkomazana, O., 2016	Co-operative inquiry group (CIG) intervention, a form of participatory action research that involves a cyclic process of planning, action, observation, and reflection	District Health Managers	Facilitated participatory action research which includes: 1. Provision of tool to record actions and reflections 2. Reflection using adapted reflectivity 5-step method 3. Provide and receive feedback	1. Adapt and tailor; 2. Evaluative & iterative strategies; 3. Develop stakeholder interrelationships; 4. Interactive assistance; 5. Train & educate stakeholders
Uduma, O., 2017	Support, Train and Empower Managers (STEM) intervention, designed to provide a structure and skill set to put human resource management policies into practice by supporting health workers in supervisory roles to provide supportive supervision	Health Facility Supervisors, District Managers	1. Workshop with district health management teams and facility managers on human resource management, 2. Intensive training in supervisory and support skills for managers directly engaged in supervision, 3. Action learning sets for staff engaged in supervision at the district and facility level which followed on from the training and continued for a period of 12 months	1. Evaluative & iterative strategies; 2. Adapt & tailor; 3. Develop stakeholder interrelationships; 4. Train & educate stakeholders

Table C. Common combination of strategies used in the case studies

Common Combination of Strategies (ERIC)	Paired Strategies
Train and educate stakeholders	Use evaluative and iterative strategies, Provide interactive assistance
Use evaluative and iterative strategies	Develop stakeholder interrelationships, Adapt and tailor to context

Common Combination of Strategies (ERIC)	Paired Strategies
Develop stakeholder interrelationships	Use evaluative and iterative strategies, Provide interactive assistance, Train and educate stakeholders
Provide interactive assistance	Train and educate stakeholders, Develop stakeholder interrelationships
Adapt and tailor to context	Use evaluative and iterative strategies, Develop stakeholder interrelationships
Engage consumers	Adapt and tailor to context, Develop stakeholder interrelationships
Support clinicians	Develop stakeholder interrelationships, Interactive assistance

Table D. Frequency of ERIC strategy thematic areas identified in the 9 studies.

Thematic Area	Frequency (# of study)	Proportion (out of the 9 study)
Use evaluative and iterative strategies	8	89%
Develop stakeholder interrelationships	8	89%
Train and educate stakeholders	6	67%
Provide interactive assistance	6	67%
Engage consumers	4	44%
Support clinicians	4	44%
Adapt and tailor to context	3	33%
Change infrastructure	1	11%

Table E: Implementation Outcomes Reported

Implementation Outcomes	Definition	Frequency
Acceptability	Perception of intervention among health managers	9
Adaptation	Modifications made to the intervention to fit the local context	6
Appropriateness	Complexity of the intervention and is it a good fit for the context	6
Feasibility	Funding, resource and staff availability to carry out the delivery strategies	6
Sustainability	Regional or national-level implementation adoption by the Ministry of Health	1

Table F: JBI quality appraisal results table

Quality appraisal questions		Included studies								
#	Questions	Bayou 2020	Nkomazana 2016	Clear y 2018	Foste r 2018	Desta 2020	Argaw 2021	Gilso n 2014	Udum a 2017	Marx 2018
1	Is the research methodology aligned with the research question or objectives?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2	Was the research conducted ethically? Consent was obtained, or there is evidence of approval from an appropriate body.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3	Were the criteria for including participants in the study clearly defined?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4	Were study subjects and the setting described in detail?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5	Is it clear in the study what comes first, the cause or the effect?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

6	Were objective and standard criteria used to measure the condition?	Yes	Unclear	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7	Was appropriate statistical analysis employed?	No	No	N/A	No	Yes	Yes	N/A	Yes	Yes
8	Were exposure and outcome measured using a valid and reliable tool?	No	No	Unclear	Unclear	Unclear	Yes	N/A	Yes	Yes
9	Were confounding factors identified and addressed?	No	No	N/A	N/A	Yes	Yes	N/A	No	No
10	Were the two groups similar and recruited from the same population?	No	No	N/A	N/A	Yes	Yes	N/A	Yes	N/A
11	Were exposures or outcomes measured similarly for both exposed and unexposed groups?	No	No	N/A	N/A	Yes	Yes	N/A	Yes	N/A
12	Was baseline information	Yes	No	N/A	Yes	Unclear	Unclear	N/A	Unclear	Yes

	n collected appropriately and matches subsequent data collection?									
13	Were participants free of the outcome at the study's start or moment of exposure?	No	No	N/A	Yes	Yes	Yes	N/A	Yes	Yes
14	Was the follow-up time reported and sufficient (>3years) for outcomes to occur?	No	N/A	N/A	No	No	No	No	No	No
15	Is there consistency between the research methodology and the interpretation of results?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
16	Study design for the article	Mixed-methods	Participatory research	Qual	Cohort	Cross-sectional	Cross-sectional	Qual	RCT	Longitudinal

CHAPTER 3. EFFECTIVENESS OF COMBINING MANAGEMENT TRAINING AND SYSTEM-LEVEL
AUDIT AND FEEDBACK STRATEGIES ON BASIC OBSTETRIC AND NEONTAL SERVICE
READINESS IN MOZAMBIQUE'S PRIMARY HEALTH CARE FACILITIES: A LONGITUDINAL STUDY
FROM 2019-2022

3.1 ABSTRACT

Background

Few studies examine how primary healthcare (PHC) managers' capacity determines evidence-based intervention implementation, particularly in sub-Saharan Africa. The Integrated District Evidence to Action (IDEAs) program was a system-level audit and feedback strategy aimed at improving the implementation of evidence-based guidelines targeting major causes of neonatal mortality in PHC facilities. Guided by the *Theory of Middle Managers' Role in Implementing Innovative Practices*, this study explored whether prior management training for PHC managers, combined with IDEAs, improved basic obstetric and neonatal service readiness in Mozambique.

Methods

We used the World Health Organization's Service Availability and Readiness Assessment survey, selecting the obstetric/neonatal module, with management training questions selected from the Health Service Delivery Indicator survey. We analyzed three repeated annual cross-sectional facility surveys (August 2019-July 2022) from both intervention and control facilities. Using controlled linear mixed-effects regression, we examined the interaction between the IDEAs program and management training on obstetric/neonatal service availability, while accounting for facility-level clustering.

Results

A total of 59 health facilities were included between 2019 to 2022. Of these, 47 (80%) had complete data across all rounds, excluding hospitals. Only twenty-three percent of managers in both intervention and control facilities reported receiving management training, despite having an average of eight years' experience in the health sector. Intervention facilities consistently had higher service readiness scores (65.9-70.9) than control facilities (64.3-69.2) across rounds. While management training and IDEAs program alone did not show a statistically significant association with service readiness, combined, they were associated with an average increase of 11.1 points out of 100 per round (95% CI: 0.7 to 21.5, $p=0.037$), after adjusting for potential confounders.

Conclusion

Our findings suggest that combining management training for PHC managers with a system-level A&F strategy improves service readiness. These results align with the Theory of Middle Managers' Role by showing that trained managers moderated the effectiveness of the intervention, supporting the idea that management capacity influences implementation outcomes. In sSA, system-level A&F interventions should target areas with management training or incorporate training as part of the implementation strategy.

Key Words

Primary Care Management, Audit and Feedback, *Theory of Middle Managers' Role in Implementing Innovative Practices*, Service Availability and Readiness Assessment, Implementation Research, Longitudinal Analysis

3.2 BACKGROUND

Universal Health Coverage (UHC) is a globally agreed-upon goal aimed at ensuring access to essential, quality healthcare services for all without financial or accessibility barriers by 2030

(14,16). For maternal and neonatal health, this includes services like antenatal care, skilled birth attendance, postnatal care, and care for complications during pregnancy and childbirth, which are critical for reducing preventable maternal and neonatal deaths through early detection of complications (16).

Primary health care (PHC) serves as the foundation of health systems, delivering comprehensive, accessible care, including maternal and child health services, and serves as an entry point to healthcare, particularly in sub-Saharan African countries (sSAs) (48,49). The World Health Organization (WHO) suggests that expanding PHC initiatives in low and middle-income countries (LMICs) could potentially save 60 million lives and increase average life expectancy by 3.7 years by 2030 (50). Primary care facility managers hold an important role in managing the delivery of these services in PHC, contributing to the realization of UHC and the reduction of preventable maternal and neonatal deaths (30,51).

Strengthening primary care management is essential for enhancing the delivery of quality and comprehensive PHC services (52). Especially when implementing an evidence-based intervention (EBI), primary care managers can serve as key moderators or mediators to optimize EBI and implementation strategies by supporting providers involved in the implementation of EBI and strategies in a given facility (53,54). Studies conducted in Mozambique, Ghana, and Uganda have demonstrated that effective primary care management leads to improvements in service availability, specifically essential drug availability and family planning services within healthcare facilities (55–57). Despite challenges such as high turnover, inadequate numbers and support of human resources for health, limited drug supplies, poor conditions of the health facilities, and inadequate budgets, primary care facilities are an important part of health systems providing maternal and child health services in many LMICs. Hence, there is need to focus on equipping those who manage these facilities to improve health service delivery even with the

various challenges mentioned above (22). Empowered and engaged primary care managers contribute to enhanced service delivery outcomes (55,58,59).

Despite their important role in health systems, primary care managers are often overlooked in global health research, national health policies, and guidelines (28). Few studies explore how primary care managers influence the implementation of EBIs in their facilities, particularly in sSAs. This gap could lead to failures to equip managers with the necessary skills to oversee primary care facilities comprehensively while implementing EBIs. These managers are variously referred to as first-line managers, middle-managers, or primary healthcare facility nurse-manager. In this study, they are referred to as primary care managers (30,47,60,61).

Guiding theoretical framework

To frame our assessment of the role of primary care managers influence on the effect of EBI implementation in PHC settings, we applied Birken et al.'s *Theory of middle managers' role in healthcare evidence-based practice* implementation. The theory suggests that middle managers, who often support front-line health care workers (HCWs) and interact with senior managers or directors, play a mediating and/or moderating role in implementing EBIs, as well as providing resources to front-line HCWs so that they have the staff, supervision, and support to address burnout (62). Specifically, they facilitate (a) disseminating information to provide employees with necessary insights about innovation implementation, (b) synthesizing information to offer relevant examples that aid in employees' comprehension of how innovations are implemented, (c) mediating between strategy and day-to-day activities to equip employees with the tools required for innovation implementation, and (d) promoting innovation implementation to encourage consistent and effective utilization by employees (54,62). In this study, we define middle managers as primary care managers because their role between senior management and front-line health workers qualifies them for this designation. This theory serves as the foundation for further examination of primary care managers' behaviors in sSAs in implementing innovative practices to facilitate improved service delivery.

The Integrated District Evidence to Action (IDEAs) program

The Audit and Feedback (A&F) strategy involves gathering information, reviewing and understanding this information in relation to performance, sharing findings with stakeholders, developing an action plan to address performance issues, and monitoring and reporting outcomes (37,63,64). The Integrated District Evidence to Action (IDEAs) program uses a 3-step cyclical A&F strategy repeated every six months: (1) A semi-annual facility and district readiness assessment report is generated from each facility using standardized tools (2). A semi-annual A&F meeting is held with MCH managers from PHC facilities, district, and provincial levels to discuss the report and develop action plans based on the findings. Each facility then creates an action plan to address priority issues (3). Support for health facilities is provided through supervision, mentorship, and financial aid to help implement these action plans. At the end of each A&F meeting, three facilities (one high-performing and two low-performing) are selected to receive targeted support, including up to two district-to-facility supervision visits provided by district health team semi-annually due to limited resources (12,65).

As suggested by middle manager theory, we hypothesized that the association between the IDEAs program and basic obstetric and neonatal service availability/readiness could be strengthened when managers at intervention sites receive formal training. Through its cyclical process, gaps in service availability were identified during A&F meetings and incorporated into action plan development and implementation. These action plans were further supported by a cash lump sum provided to health facilities within a district to facilitate implementation. With trained PHC managers, the implementation climate would be enhanced, improving the effectiveness of IDEAs.

Study aims

Our aim was to first examine the individual effects of IDEAs intervention and formal management training on basic obstetric and neonatal service availability in Mozambique. Then, guided by the *Theory of middle managers' role in healthcare evidence-based practice*, we evaluated whether formal management training

for primary care managers enhances the effect of the IDEAs intervention in improving maternal and child health service availability.

3.3 METHODS

Study design

We conducted a facility-level longitudinal analysis of two repeated annual cross-sectional facility-based surveys collected between August 2019 and July 2022, across intervention and control facilities. This study is a secondary outcome analysis that was not included in the initial study proposal, separate from the primary outcome of the IDEAs program impact evaluation.

Study setting

Mozambique is located in southeastern Africa, with an estimated population of 32 million in 2023, where 65% live in rural areas (66). Administratively, the country is divided into 11 provinces and 154 districts (22,66,67). Among 1643 public health facilities, 1575 (96%) offered primary healthcare services (22). The IDEAs program was implemented in 154 public-PHC facilities over five years in 12 high-population districts in Manica and Sofala provinces (figure 1) located in central Mozambique (12,65). Control districts (n=13) were matched districts from neighboring provinces, Tete and Zambezia, including one district from Sofala province (figure 1). Primary care managers in Mozambique's public sector facilities oversee day-to-day operations and supervise frontline staff; meanwhile, district health management teams manage and coordinate PHC facilities while reporting to provincial health directorates (48,57). All facilities included in this study were government owned PHC facilities.

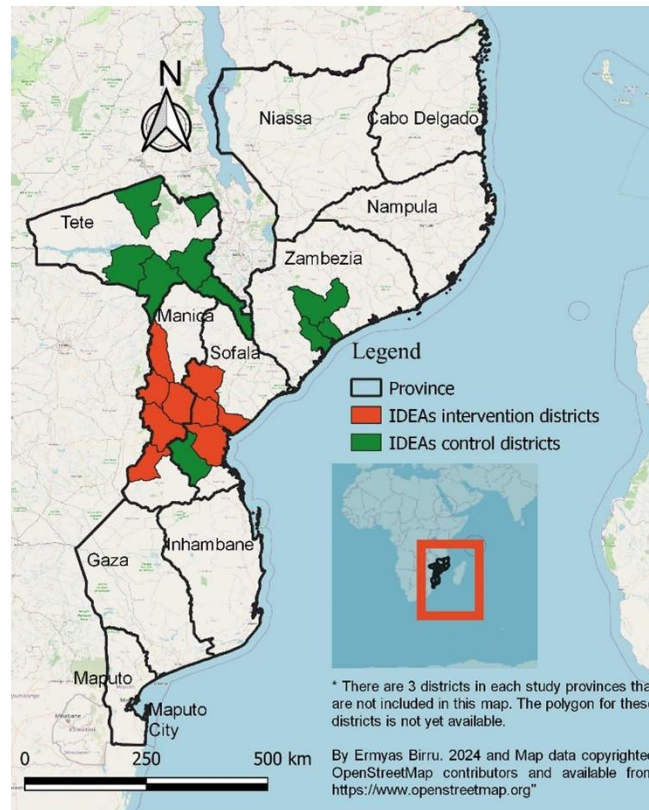


Figure 1: Map of Mozambique with IDEAs intervention and control districts

Primary care managers were surveyed using two instruments, the Health Service Delivery Indicator (SDI) and World Health Organization's Service Availability and Readiness Assessment (SARA) surveys, in three rounds conducted annually between August 2019 and July 2022. The first instrument was the health Service Delivery Indicators (SDI) survey from the World Bank, specifically the Portuguese version previously used in Mozambique in 2014 (68). The SDI survey evaluates service delivery quality related to factors including policy and institutional environments and consists of 46 health-related questions. The second instrument was the SARA survey, where we specifically assessed basic obstetric and neonatal service section as an indicator for maternal and child health service availability (69). We chose basic obstetric and neonatal service availability since this was the main service provided by all primary healthcare facilities in Mozambique. Further details about these surveys and the data collection dates can be found in the supplement (table 1 and 2).

SDI Survey

For the SDI survey, we adapted seven domains focusing on management practices, external supervision, and community health committees. These adapted questions were designed to gather information on managers' work experience, exposure to formal management training, and contextual factors influencing optimal health facility management (68). From this survey, we selected variables exclusively from management experience and training domain. We focused only on the management training component, as our primary interest was in assessing the interaction effect of training and the IDEAs A&F strategy on service readiness. Detailed information on the overall SDI survey collected for this study, as well as the overall IDEAs study, can be found in supplement (table 3).

SARA Survey

The SARA survey included tracer items (questionnaires) grouped into the four general service domains recommended by the WHO: basic amenities (water, sanitation, electricity), equipment, medicines, and commodities, and trained staff with availability of essential care guidelines (69). We anticipated that these indicators would be impacted by the intervention and management training, as the cyclical process of IDEAs was designed to improve the availability, delivery, and outcomes of maternal and child health programs in these facilities. List of indicators included for this survey is included in supplement (table 4).

Data were collected using a tablet with REDcap (70) software loaded with the SDI and SARA surveys, routinely validated by the research team for data quality before and after data collection.

Health Facility Selection

Of the 154 health facilities in the IDEAS overall study, due to limited resources and time for evaluation, 72 primary healthcare facilities were sampled. These 72 facilities were divided equally, with 36 facilities selected in each group (control and intervention) and matched based on population catchment size, facility type, and distance from the district to provincial capital (12). After excluding primary care hospitals with broad service provisions and facilities with incomplete SDI or SARA surveys, the final sample comprised 59 primary care facilities that completed both surveys across three rounds, though the second

round included data from only 56 health facilities. This lower number in round 2 could be due to availability of managers to take the survey at the time of data collection.

Outcome measurement and explanatory variables

The outcome measured in this study was basic obstetric and neonatal service readiness, assessed on a scale of 0–100, with 100 indicating complete service availability. The domain score was estimated as the average availability of tracer items (proportion of selected items) from the SARA list multiplied by 100. The overall obstetric and neonatal service readiness was calculated by averaging the scores of each domain, then multiplying by 100, giving a score between 0–100. Service availability data were independent for each round, meaning the scores for the same facility differed in each data collection round. This calculation was adopted from the SARA survey tool provided by the WHO (69).

The study had two main explanatory variables, both captured through “yes” or “no” responses in the individual-level SDI survey conducted at each health facility. The first variable assessed whether a manager had received formal management training unrelated to the IDEAs intervention. The second variable captured participation in the IDEAs program.

The same managers may have participated in multiple SDI survey rounds. To ensure consistency in the data regarding management training status, we conducted data validation to flag repeated cases. If the same managers were surveyed in different rounds and reported receiving training in earlier rounds but not in subsequent ones, we assumed they received training throughout the subsequent rounds to avoid potential reporting errors.

To adjust for external factors that might influence service availability, both time-varying and non-time-varying variables were included. Time-varying variables included whether the managers reported this as their first time being the head of the facility, their average years of experience as a manager in the health unit, rounds of data collection, and the number of supervisions received by district health facility staff in the six months preceding data collection, which includes administrative supervisions aimed at supporting

overall facility management. We included a random effect at the facility-level to control for all non-time-varying factors (e.g distance from the district health office, average annual facility-based delivery, etc).

Descriptive analysis

We began our analysis by conducting descriptive statistics to examine the distribution of responses for indicators selected from the two surveys. For our descriptive overview table, we compiled the mean and standard deviation (SD). Responses were grouped by round, intervention arm (control vs. intervention), and survey type.

Mixed-effect linear regression analysis

To analyze the individual effects of IDEAs and training on service availability, as well as to evaluate the potential interaction between the IDEAs intervention and formal management training and their impact on health facility readiness for basic obstetric and neonatal services, we applied linear mixed-effect regression (Equation 1). We included a random effect at the health facility level to control for all non-time-varying factors in our model and to reduce possible clustering. Our primary predictors included whether the facility manager received formal management training (self-reported) and whether they were in the IDEAs intervention or control arm, with both time-varying and non-time-varying factors adjusted for possible confounders.

Equation 1: Linear mixed effect regression model

$$Y_{it} = \beta_0 + b_i + \beta_1 \cdot \text{round } 2 + \beta_2 \cdot \text{round } 3 + \beta_3 \cdot \text{intervention} + \beta_4 \cdot \text{mgmt_training} + \beta_5 \cdot \text{DHMT supervision} + \beta_6 \cdot \text{Administrative supervision} + \beta_7 \cdot \text{Years in health sector} + \beta_8 \cdot \text{years_as head of current health center unit} + \beta_9 \cdot \text{mgmt_training} \times \text{intervention} + u_{\text{health facility}} + \epsilon$$

Explanation:

Y_{it} : Represents the service availability score at time point t (round 2 or 3).

b_i : Random intercept term.

ϵ : Residuals.

Model Parameters:

β_0 : Intercept. This represents the expected service availability score for facilities in the control group (no intervention, no management training, no supervision, less than one year experience in health sector or as head of the health facility). Note: This refers to the baseline score (round 1) as round 1.

β_1 : Coefficient for round 2.

β_2 : Coefficient for round 3.

β_3 : Intervention effect. Positive β_3 indicates higher service availability in the intervention sites.

β_4 : Management training effect. Positive β_4 indicates higher service availability related to having received management training.

β_5 : Coefficient for number of semi-annual DHMT supervisions.

β_6 : Coefficient for number of DHMT supervision for non-clinical administrative supervisions

β_7 : Coefficient for average years of experience in the health sector.

β_8 : Coefficient for average years of experience as a manager in the facility.

β_9 : Interaction term. Positive β_9 suggests a stronger effect of management training when combined with the intervention or vice versa.

$u_{\text{health facility}}$: Random intercept term for each facility, accounting for unobserved facility-level effects.

For the sensitivity analysis, we first ran a model without the interaction between intervention and management training. This allowed us to test how the magnitude and direction of the covariates changed when the interaction variable was included. Second, we performed additional tests by dropping and adding non-main predictor covariates to observe the impact on the estimated results. Third, we ran a model with only the outcome, time variables (rounds), and explanatory variables, excluding any potential confounding indicators. We tested how well a model fit using AIC and BIC, which are measures of how well a model fits the data, with lower values indicating a better fit.

All statistical tests were two-sided, and p-values of less than 0.05 were considered statistically significant. The analysis was conducted using R version 4.1.3 (71), and we followed the STROBE combined guideline for reporting elements of this study (refer to additional file 1) (72). To detect multicollinearity in our regression model (value below 5), we calculated the generalized Variance Inflation Factor (VIF) for the linear regression model (73).

3.4 RESULTS

Overview of health facility manager survey response

Managers' participation in the SDI survey was consistent across rounds, with 59 managers interviewed in rounds 1 and 3, while 56 were interviewed in round 2 across intervention and comparison facilities. Of the 59 health facilities included in this study, only 47 (80%) had complete data for all variables included in this regression analysis. We observed an approximately equal distribution of participants between control versus intervention facilities (Table 1). The average number of monthly supervisions conducted by District Health Management team (DHM) to study facilities in the preceding six months showed an increasing trend: from 4.0 (SD = 2.8) in round 1, to 4.4 (SD = 4.7) in round 2, and to 7.4 (SD = 16.9) in round 3. Additionally, the average number of administrative supervisions, part of the overall supportive supervision, but dedicated for administrative (finance, management, human resource) related support, averaged around 1.1 (SD = 0.3) in rounds 1 and 2, and slightly increased to 1.3 (SD = 0.5) in round 3. Of those included in this study, 37.3% of the managers were first-time head of a health facility. Only 23% of the managers (who are also health care workers) reported receiving formal management training despite having an average of 8 years of experience working in the health sector. The types of formal management training varied: on average, 66.0% attended short courses of less than a month, 7.5% attended short courses of more than a month, 15.4% attended one or more courses as part of medical training, and 11.3% reported other types of training (Table 1). Further details about the guidelines for the training of the cadres provided, how the managers accessed the training, or why certain areas received training while others did not, were not included in the survey.

Table 4: Overview of survey responses

Survey Area	Indicator	Round 1 N (%) or Mean (SD)	Round 2 N (%) or Mean (SD)	Round 3 N (%) or Mean (SD)
Total surveyed	Total number of health facility manager interviewed	59	56	59
	Control	28 (47.4)	28 (50.0)	28 (47.4)
	Intervention	31 (52.5)	28 (50.0)	31 (52.5)
District health management	Average number of monthly supervisions conducted by DHM to all facilities in the past 6 months (SD)	4.0 (2.8)	4.4 (4.7)	7.4 (16.9)

(DHM) team supervision	Of the supervisions conducted by DHM, average number of administrative supervision (Proportion of total monthly supervision conducted)	1.1 (0.3)	1.1 (0.3)	1.3 (0.5)
Health Facility manager survey responses	Average years practiced in the health sector	6.8 (7.7)	9.4 (9.1)	8.0 (7.2)
	Average years as head of the health unit (SD)	1.7 (1.9)	1.9 (1.9)	2.2 (2.6)
	First time as head of a health facility	57	52	55
	Yes	17 (29.8)	23 (43.4)	22 (38.6)
	No	40 (70.2)	29 (54.7)	33 (57.9)
	Did not received formal management training	44 (77.2)	43 (81.1)	41 (71.9)
	Received formal management training	13 (22.8)	10 (18.9)	16 (28.1)
	Control	12 (92.3)	5 (50.0)	10 (62.5)
	Intervention	1 (7.7)	5 (50.0)	6 (37.5)
	Formal Management training types	13	10	16
	A short course (less than a month)	6 (46.2)	7 (70.0)	13 (81.2)
	A short course (more than a month)	0 (0.0)	1 (10.0)	2 (12.5)
	One or more courses as part of my medical training	6 (46.2)	0 (0.0)	0 (0.0)
	Other	1 (7.7)	2 (20.0)	1 (6.2)
	Control (SD)	67.9 (14.6)	65.9 (10.0)	64.3 (11.8)
Service Readiness scores out of 100	Intervention (SD)	70.9 (12.7)	69.2 (11.9)	67.0 (11.7)

Overview of service availability

The service availability scores showed a slight increase in service availability at intervention facilities compared to control facilities across rounds, with scores ranging from 64.3 to 70.9 and 65.9 to 69.2, respectively (Table 1). Scores are consistently reported out of 100, revealing a general upward trend in both groups, with the Intervention group often showing marginal improvements, particularly in Trained Staff & Guidelines (figure 2). Basic Amenities consistently scored highest (around 90), while Medicines & Commodities typically had the lowest scores (around 50-60). The Intervention group demonstrated slight advantages in most categories, suggesting potential positive impacts of the intervention strategy, though the differences were not dramatically large.

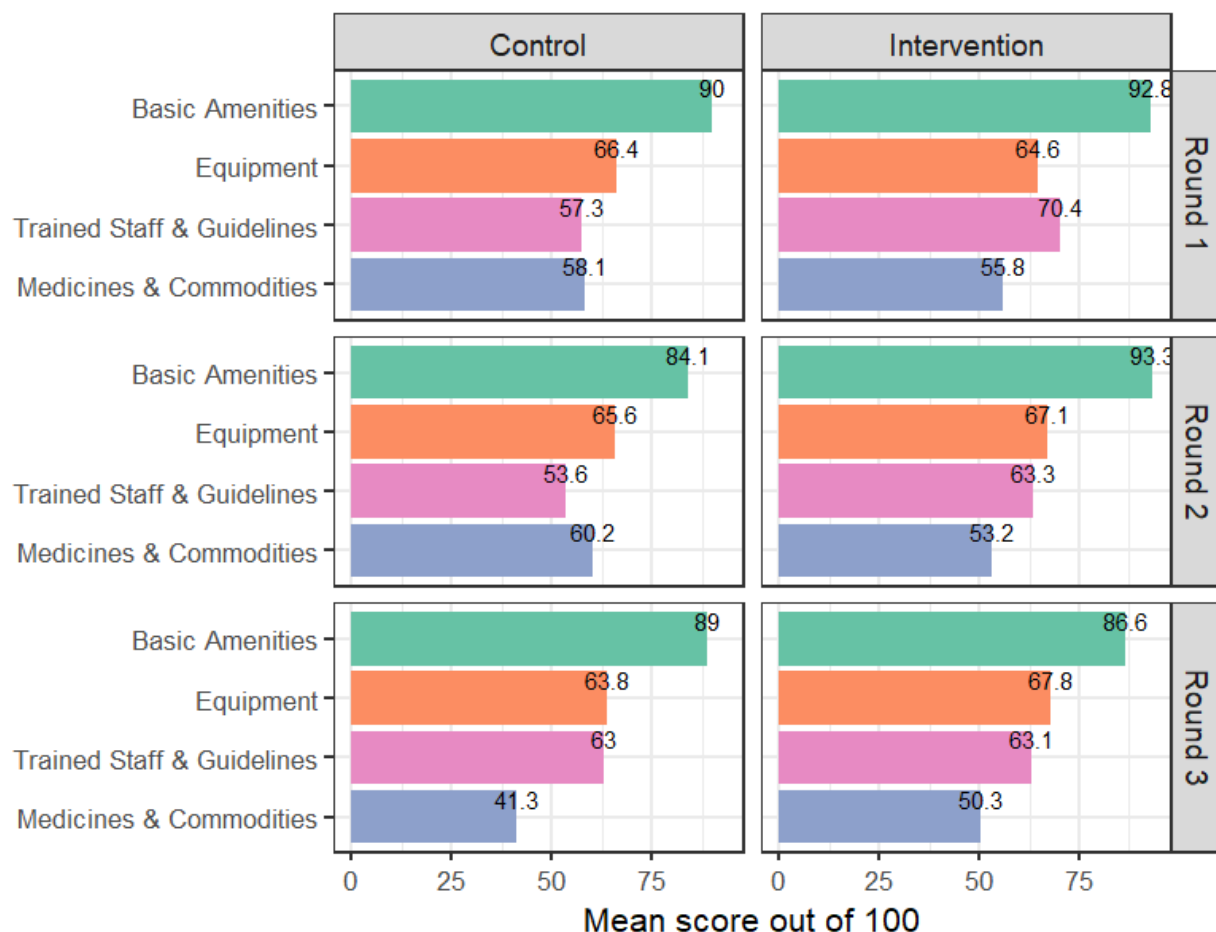


Figure 2: Mean availability of key service readiness indicators across intervention and control sites by round, as per the WHO SARA metrics. The scores are out of 100, with higher values indicating better service availability in facilities.

Regression results: Individual and interaction effect assessment

Results from our mixed-effects regression analysis (Table 2) highlighted that service availability significantly decreased in rounds 2 and 3 compared to the baseline (round 1), with differences of -4.5 (95% CI: -8.2 to -0.2, $p=0.041$) and -6.8 (95% CI: -11.1 to -2.4, $p=0.002$), respectively. Testing the interaction between the IDEAs intervention and management training revealed a significant increase in service availability by 11.1 points (95% CI: 0.7 to 21.5, $p=0.037$), after adjusting for possible confounders. The IDEAs intervention and management training by themselves did not have a statistically significant effect on service availability. Similarly, we did not find a statistically significant association between service availability and DHMT semi-annual supervision, average years of experience in the health sector, or average years of experience as managers in the facility where they were surveyed.

Table 2: Mixed effect regression analysis results

Indicators	Estimates	Confidence Interval (CI)	P-Value
Intercept	64.8	56.6 – 73.0	<0.001
Round 2	-4.5	-8.9 – -0.2	0.041
Round 3	-6.8	-11.1 – -2.4	0.002
Intervention (IDEAs)	1.1	-4.9 – 7.1	0.708
Prior management training	-2.7	-9.3 – 4.0	0.431
Semi-annual district health management team (DHMT) supervisions	-0.2	-0.7 – 0.2	0.291
DHMT supervision for non-clinical administrative supervisions	3	-2.5 – 8.5	0.284
Average years of experience in the health sector	0.3	-0.0 – 0.5	0.085
Average years of experience as a manager in the facility	0.6	-0.4 – 1.6	0.258
Interaction: Intervention (IDEAs) X management training	11.1	0.7 – 21.5	0.037

Sensitivity Analysis

Results from a likelihood test on model fit indicate a significant difference between the two models – model with interaction and without, with a chi-squared value of 4.8 and a p-value of 0.029, suggesting that adding the interaction term between health facility management training and IDEAs intervention improves the fit of the model. The model with the interaction term has a lower AIC and BIC compared to non-interaction model, indicating a better fit of the former model to the data. This suggests that the interaction between management training and intervention significantly influences service availability in our study. Dropping and adding covariates did not make a significant difference when compared to our main analysis. Unadjusted model with only the outcome, time variables (rounds), an explanatory variable, excluding any potential confounding indicators showed similar magnitude and direction in the effect of the interaction. Results from these models can be found in supplement (table 5).

Generally, a VIF value greater than 2 suggests multicollinearity. In this analysis, all predictors have VIF values below 2, indicating no multicollinearity between predictor and confounder variables. The VIF analysis table is included below in supplement (table 6).

3.5 DISCUSSION

Our study aimed to explore the effectiveness of combining an A&F strategy with management training on basic obstetric and neonatal service readiness in Mozambique's health facilities. Based on our results, neither management training nor the A&F intervention alone showed a statistically significant association with service readiness. However, when both were implemented together, we found a statistically significant interaction effect on service readiness. These findings suggest that the impact of the A&F strategy on improving service availability was significantly greater when health facility managers had received formal management training. This indicates that capacitated managers are more effective in implementing an A&F strategy to enhance the quality of services in PHC settings. Our findings support the *Theory of Middle Managers' Role in Implementing Innovative Practices*, which states that managers play a key role in improving the implementation climate to enhance the effectiveness of strategies in improving health or implementation outcomes, suggesting that 23% of managers with past management training were better implementers of IDEAs.

This study aligns with a previous comprehensive systematic review that identified strategies designed to improve healthcare provider performance in LMICs, which directly influence service readiness. This systematic review found that performance improved more when training was combined with other strategies such as supervision and group problem solving, similar to and A&F strategy (74). A study from Malawi on management strategies for integrating depression care in Non Communicable Disease (NCDs) clinics found that hands-on management strengthening through daily engagement in operations, receipt of mentorship, and a culture of proactive problem-solving nurtured a positive implementation climate and raised awareness about mental healthcare importance among providers (75). A study from South Africa reported that health facility staff found adopting top-down staff's policies and guidelines difficult and often perceived their introduction as disempowering, underscoring how important local managers can be in reducing challenges in facilitating innovation introduction and relevance (76). A study in Norway found that poor management capacity, expressed as workplace autonomy and leadership capacity, hindered

first-line managers' adoption and sustained implementation of A&F cycles at a district psychiatric center, ultimately limiting the potential impact of A&F strategies (61).

Our study examined the interaction between the IDEAs program and formal management training. A more comprehensive evaluation of the IDEAs program's impact on various maternal and child health outcomes is underway. For this reason, we chose not to further discuss program's overall effectiveness in this paper. However, it is important to note that availability of service could be an important prerequisite for quality improvement, as efforts to enhance service quality may be limited if access to care remains a barrier. The A&F approach within the IDEAs program could not only support quality improvement but also help identify and address gaps in service availability. Which raises an important point where the relationship between A&F strategy and availability could be bidirectional.

The study does have limitations. First, there is the potential for recall bias, where managers may have forgotten if they reported receiving training in previous rounds. Second, information bias may be present due to inconsistent understanding among respondents about what constitutes "formal management training". Additionally, due to time and resource constraints, the survey did not capture details beyond who received the training, the duration of the training, and minor details about a few of the training types, such as those provided during medical school. Furthermore, we did not define specific components within the training that may have interacted with the A&F strategy and influenced the observed results. We were not able to assess the degree to which lack of overall resources, human resource salary levels and payment, physical conditions, and resulting morale etc, which might have affected the link between training/A&F and outcomes.

As for our methods, one key limitation of this study is the small sample size in the number of health facility managers with formal management training in intervention facilities. This limited sample size may have affected the statistical power of the analysis, potentially influencing the robustness of the findings. Although we observed a significant interaction effect, the non-significant main effects may suggest that the sample size was insufficient to detect more stable estimates. Given the complexity of our model and

the relatively small number of managers with formal training, there is a possibility that the estimates could be unstable. We acknowledge the importance of conducting a power analysis to assess whether the sample size is sufficient for the complexity of our model. Given the small sample size and the inclusion of interaction terms, we attempted to conduct a post hoc power analysis. However, we encountered challenges with observed power calculations, which can be misleading due to their dependency on the estimated effect size from the sample. Additionally, the small number of facilities with trained managers further limits the reliability of such an analysis. Given these limitations, we recommend that future studies conduct priori power analysis before data collection to ensure an adequate sample size for detecting interaction effects. Additionally, a simpler model might be considered to improve estimate stability in settings with similar sample size constraints

To minimize risks and biases, we incorporated several strategies into the study design. We controlled potential confounders by including relevant covariates such as average years of experience, type of health facility, and distance to the district health management office. Additionally, we used a mixed-effects regression model to account for both time-varying and non-time-varying factors. Random effects at the facility level were included to control unobserved heterogeneity. Regular training and supervision were part of the protocol to ensure data quality and consistency. These measures collectively helped reduce the impact of biases on the study's outcomes.

Despite these limitations, our study supports the importance of doing both management training and A&F, and that they make a difference in health service delivery outcome. On the other hand, our study could serve as a useful reference for future research and for testing and adapting strategies in different contexts to support and capacitate primary care managers in effectively delivering health services. As for survey tools, WHO has developed a comprehensive facility assessment tool called the Harmonized Health Facility Assessment (HHFA) framework, which integrates SARA, SDI, and USAID's Service Provision Assessment (SPA) tool, along with detailed guidelines for users (77). HHFA tool will facilitate data collection for future studies in various settings, as it consolidates assessment tools and provides standardized guidelines for data collection, analysis, and reporting.

To the best of our knowledge, our study is the first to empirically test the Birken et al. (2017) Middle Manager Theory in the context of health systems within sSA. While further testing of the theory would be beneficial, our findings offer valuable insights into the potential impact of formal management training in PHC delivery. The study's relevance may extend to a range of similar settings, particularly other PHC settings in sSA. Our approach may serve as a model to adapt to further evaluate the synergistic effect of management during strategy implementation in settings reliant on health centers.

Further research is needed to evaluate the implementation of innovative strategies for health facility-based EBIs particularly focusing on how general management skills or training influence implementation effectiveness and other outcomes. A more effective tool to measure management effectiveness and coverage is essential for providing targeted support to health center managers. Future studies could explore both moderator and mediation analyses to enhance EBIs and improve implementation effectiveness, specifically exploring mechanisms with effective management that enhance uptake of innovation. Scaling up multi-component A&F strategies, in conjunction with formal management training, has the potential to enhance maternal and child health services in sSA. Additionally, further research should incorporate external factors such as adequacy and working conditions, as well as power dynamics, to understand how these factors might affect the impact of management training and A&F strategies.

3.6 CONCLUSION

Addressing system-level implementation practices is beneficial in the long term to improve comprehensive service delivery in sSA countries to achieve UHC and 2030 Sustainable Development Goals (SDG) targets related to maternal and child health. Our findings suggest that while management training and the A&F strategy alone did not show a significant impact on service readiness, their combined implementation had a meaningful interaction effect. This indicates that trained managers play a key role in enhancing the effectiveness of A&F strategies, ultimately improving service availability. These

results highlight the importance of integrating management training into quality improvement initiatives to strengthen PHC services.

Our next step is to assess the cost of implementing IDEAs and incorporating a model for formal management training in subsequent iterations. We hope this study encourages global health implementation science stakeholders to move beyond application of frameworks, and critically considering theories to understand mechanisms that enable or hinder EBI implementation strategies to improve health service delivery and maternal and child health outcomes.

3.7 LIST OF ABBREVIATION

A&F: Audit and Feedback

DHMT: District Health Management Team

IDEAs: Integrated District Evidence to Action

LIMCs: Low- and Middle-Income Countries

MCH: Maternal and Child Health

MOH: Ministry of Health

SDI: Service Delivery Indicators

SARA: Service Availability and Readiness Assessment

STROBE: Strengthening the Reporting of Observational Studies in Epidemiology

sSA; sub-Saharan Africa

VIF: Variance Inflation Factor

WHO: World Health Organization

Declarations**Ethics Statement**

The study was approved by the institutional review board of the University of Washington (IRB#STUDY00003926), Mozambique's National Bioethics Committee for Health (CNBS-IRB00002657), and the Ministry of Health after endorsement from Manica and Sofala Provincial Health Directorates. Informed consent was waived by the Mozambique's National Bioethics Committee for Health.

Consent for Publication

Not applicable

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare no competing interests.

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Author's contribution

EB and KS conceived the study idea. BJW, KS, and EB designed the study and selected the theory. EB conducted a literature search. EB, AD, AG, and ST collected the data. EB extracted the data and performed the analysis and synthesis of the results with OA, and received analysis advice from BHW, LRH, BJW, SGL, and KS. EB drafted the manuscript, which was critically revised by KS, LRH, BJW,

BHW, GJW, IR, QF, SG, and all other authors provided detailed feedback on subsequent drafts and approved the final version. All authors reviewed and approved the submitted manuscript.

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We hope this study sparks interest in supporting primary healthcare facility managers in sub-Saharan Africa who often get overlooked. These managers are key personnel in helping frontline workers and running daily operations, especially in areas with limited resources. Second, great appreciation to our data collectors who visited these facilities, some in remote areas, so that we could collectively share important lessons learned from this research. Also, we would like to thank Stephen Pope, who previously worked with the two surveys included in this study – providing background information whenever needed. Lastly, we give the utmost gratitude to the Ministry of Health of Mozambique and the team at the University of Washington's Global Health Implementation Science Program for the valuable guidance and support. Their ongoing partnership help make sure people access quality healthcare in Mozambique and beyond.

3.8 LIST OF ADDITIONAL TABLES

Table 4 STROBE Statement

Section	Item No	Recommendation	Page No
Title and Abstract	1 (a)	Indicate the study's design with a commonly used term in the title or the abstract	42
	1 (b)	Provide in the abstract an informative and balanced summary of what was done and what was found	43–44
Introduction	2	Explain the scientific background and rationale for the investigation being reported	45–47
	3	State specific objectives, including any prespecified hypotheses	47
Methods	4	Present key elements of study design early in the paper	48

5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	48–49
6 (a)	Describe eligibility criteria, sources and methods of selection of participants, and follow-up (based on study type)	50–51
6 (b)	For matched studies, provide matching criteria and number of exposed/unexposed or controls per case	50
7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Include diagnostic criteria if applicable	52–53
8*	For each variable of interest, provide data sources and methods of assessment; describe comparability between groups if applicable	50
9	Describe efforts to address potential sources of bias	53
10	Explain how the study size was determined	50
11	Explain how quantitative variables were handled in the analysis, including groupings and rationale	50–53
12 (a)	Describe all statistical methods, including those used to control for confounding	52–53
12 (b)	Describe any methods used to examine subgroups and interactions	52–53
12 (c)	Explain how missing data were addressed	NA

	12 (d)	Explain how loss to follow-up, matching, or sampling strategy was addressed (depending on study type)	NA
	12 (e)	Describe any sensitivity analyses	52–53
Results	13* (a)	Report participant numbers at each stage (e.g., eligibility, inclusion, follow-up, analysis)	54–55
	13* (b)	Provide reasons for non-participation at each stage	54–55
	13* (c)	Consider use of a flow diagram	NA
	14* (a)	Provide characteristics of study participants and data on exposures/confounders	54–55
	14* (b)	Indicate number of*	
	14* (c)	Summarize follow-up time for cohort studies	NA
	15*	Report outcome events or summary measures (based on study type)	56 (Cohort only)
	16 (a)	Report unadjusted and adjusted estimates with precision; clarify adjusted confounders	55–56
	16 (b)	Report category boundaries when continuous variables are categorized	NA
	16 (c)	Consider translating relative risk into absolute risk	NA
	17	Report other analyses (e.g., subgroup, interaction, sensitivity)	56–57
Discussion	18	Summarize key results in relation to objectives	58
	19	Discuss study limitations, sources of bias, direction and magnitude	59–60

	20	Provide a cautious interpretation in light of objectives, limitations, and other evidence	59–60
	21	Discuss generalizability (external validity) of results	59–61
Other Information	22	Provide funding sources and role of funders	64

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Table 5: overview of study survey instruments

Instrument Name	Description	Unit	Target group	Data collection	Design
1. Health facility management effectiveness survey: <i>Health facility manager</i>	Captures facility-level information about management procedures from Health facility managers	Facility	Head of facility managers	Four rounds (2018-2022)	<i>Same survey conducted in different rounds among health facility managers at the time of the data collection visit</i>
2. Service Availability and Readiness Assessment	Captures facility readiness to provide various health services. For this study we selected the basic obstetric and neonatal service.	Facility	Health facility manager	Three rounds (2019-2022)	Same survey conducted among participating facilities. Only rounds 2-4 had data collection for the obstetric and neonatal service.

Table 6: Data collection rounds and timeline

Data collection round	Date of first record	Date of last record	Surveys collected
Round 1	8/9/2019	5/7/2020	Health facility manager and basic OB and neo SARA survey
Round 2	8/12/2020	3/4/2021	Health facility manager and basic OB and neo SARA survey
Round 3	8/3/2021	2/22/2022	Health facility manager and basic OB and neo SARA survey

Table 7: Domains included in the Health Service Delivery Indicators in this study

Domain	Items	Total Items
Barrier to Facility Full Functionality	Barrier to facility full functionality	1
Supervision by Central Team	Supervisor visits, Supervision mentorship areas, Last supervisor visit details, Issues raised during supervision, Equipment, infrastructure, and supplies	20
Time Management	Days and hours worked per week, Time spent on different activities, Supervising patient flow, Supervising clinical staff, Task distribution, Administrative tasks, Equipment and medicine checks, Patient treatment, Relationship management	12
Management Practices	Medicine ordering and receipt times, Absences of health workers, Performance evaluation meetings, Factors influencing performance opinions, External supervisor evaluations, Performance assessment impact on salary/incentives, Stock breakages, Medicine ordering frequency	14
Experience	Years in health sector, Years as head of unit, Previous experience as head of a health unit, Official management training received, Experience as a director/manager outside health sector	8
Community Participation	Existence of Health Management Committee, Number of committee members, Meeting frequency, Community representative participation, Minutes availability, Use of overhead funds for various items	12
Patient Feedback	Formal mechanisms for obtaining patient feedback, Most common patient complaints, Changes made due to patient feedback	8

Table 8: SARA tracer indicators for basic obstetric and neonatal service readiness used in this study(n=67)

Domain	Items	Total Items
Basic Amenities	Energy available, Water available, Working toilets, Working private toilet	4
Routine Practices	Administration of oxytocin injection, Immediate and exclusive breastfeeding, Hygienic cord care, Thermal protection	4
Obstetric Signal	Parenteral administration of antibiotics, Parenteral administration of oxytocic, Parenteral administration of magnesium sulphate, Assisted vaginal delivery, Removal of retained products after delivery	5
Newborn Signal	Neonatal resuscitation, Cesarean section, Blood transfusion, Antibiotics for preterm or prolonged PROM, Corticosteroids in preterm labor, Kangaroo mother care, Injectable antibiotics for neonatal sepsis	7
Staff and Guidelines	Guidelines for essential childbirth care, Essential Birth Care checklists/job aids, National guideline on Essential Care for newborns, Staff trained in newborn resuscitation in the last two years, Staff trained in essential childbirth care	5
Equipment	Ambulance vehicles in operation, Electric autoclave (pressure & moist heat), Wood autoclave, Gas autoclave, Examination light, Delivery pack, Cord clamp, Episiotomy scissors, Scissors/blade to cut cord, Structure material with needle, Needle holder, Manual vacuum extractor, Vacuum aspirator or D&C kit, Disposable latex gloves, Blank partograph, Delivery bed, Newborn bag and mask (term babies), Newborn bag and mask (pre-term babies), Electric suction pump, Suction catheter, Suction bulb (single use), Suction bulb (sterilizable multi-use), Speculum, Infant weighing scale, Blood pressure apparatus	24

Medicines and Commodities	Antibiotic eye ointment for newborn, Gentamicin injection, Ampicillin powder for injection, Hydralazine injection, Metronidazole injection, Azithromycin cap/tab or oral liquid, Cefixime cap/tab, Benzathine benzylpenicillin powder for injection, Nifedipine cap/tab, Metildopa tablets, Calcium gluconate injection, Magnesium sulphate injectable, Skin disinfectant, Intravenous solution with infusion set, Sodium chloride injectable solution, Dexamethasone injection, Oxytocin injection, Oxytocin stored in cold storage	18
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Table 9: Regression analysis results comparing unadjusted and adjusted model

	service readiness (unadjusted)			service readiness (adjusted)		
<i>Predictors</i>	<i>Estimates</i>	<i>CI</i>	<i>p</i>	<i>Estimates</i>	<i>CI</i>	<i>p</i>
Intercept	70.00	64.87 – 75.13	<0.001	64.78	56.55 – 73.02	<0.001
Round 2	-3.55	-7.30 – 0.21	0.064	-4.53	-8.86 – -0.20	0.041
Round 3	-5.43	-9.12 – -1.73	0.004	-6.75	-11.07 – -2.43	0.002
Intervention (IDEAs)	0.69	-5.40 – 6.77	0.824	1.14	-4.86 – 7.13	0.708
mgmtTrainingPrior: Yes	-2.13	-8.12 – 3.86	0.484	-2.65	-9.29 – 3.99	0.431
Interaction: Intervention (IDEAs) X mgmtTrainingPrior: Yes	9.52	0.18 – 18.85	0.046	11.11	0.69 – 21.52	0.037
Semi-annual district health management team (DHMT) supervisions				-0.23	-0.65 – 0.20	0.291
DHMT supervision for non-clinical administrative supervisions				2.97	-2.50 – 8.45	0.284
Average years of experience in the health sector				0.25	-0.03 – 0.53	0.085
Average years of experience as a manager in the facility				0.58	-0.43 – 1.59	0.258

Table 10: VIF analysis results

Predictor	GVIF	Df	$GVIF^{1/(2 \cdot Df)}$
as.factor(round)	1.321663	2	1.072211
Intervention (IDEAs)	1.230781	1	1.169572
mgmtTrainingPrior	1.95026	1	1.35592
Semi-annual DHMT supervisions	1.107535	1	1.086109
DHMT supervision for non-clinical administrative supervisions	1.161209	1	1.069028
Average years of experience in the health sector	1.12885	1	1.053514
Average years of experience as a manager in the facility	1.060425	1	1.190976
Interaction: Intervention (IDEAs) X mgmtTrainingPrior: Yes	2.089364	1	1.344178

CHAPTER 4. COSTS OF AN AUDIT AND FEEDBACK STRATEGY TO IMPROVE THE UPTAKE OF
MATERNAL AND CHILD HEALTH GUIDELINES IN MOZAMBIQUE'S PRIMARY HEALTH CARE
SETTING

4.1 ABSTRACT

Background

Despite high coverage of facility-based maternal and child health (MCH) services in Mozambique, preventable maternal and neonatal deaths remain among the highest globally. To address this, the Integrated District Evidence-to-Action (IDEAs) program was implemented from 2016 to 2020 in central Mozambique as a facility-level audit and feedback (A&F) strategy. IDEAs adapted traditional A&F into three components: (1) biannual facility readiness assessments, (2) A&F meetings to develop action plans, and (3) supportive supervision with funding for implementation. This study estimates total and component-specific implementation costs of IDEAs and compares them to average district health budgets.

Methods

Costs were estimated from a payer perspective following CHEERS guidelines, using both gross and microcosting methods. Costs were annualized over five years (2016–2020) with a 3% discount rate and are reported in 2020 USD. Staff time estimates were based on program staff interviews and national salary data. Outcomes include average cost per district and total annual cost by intervention component. We conducted a one-way or deterministic sensitivity analysis to identify which cost drivers have the most significant impact on the overall cost.

Results

The IDEAs programs total (2016-2020) incurred total costs were \$2,224,341 (2020 USD), with \$1,702,648 (76.5%) for recurrent expenses and \$495,323 (22.3%) for Capital expenses. Average annual district-level costs were \$41,967, including A&F meetings (\$10,893; 26.0%), Capital expenditures (\$8,255; 19.7%), targeted support (\$9,323; 22.2%) — which includes \$5,700 (13.6%) for district-level cash transfers and \$3,623 (8.6%) for facility supervision, and readiness assessments (\$6,351; 15.1%). Per diems accounted for 52.0% of A&F meeting costs. IDEAs represented approximately 6.6% of an average district health budgets. Implementation involved 33 participants with 2,560 hours yearly per

district. When applying a standard 25% increase or decrease to selected cost drivers we found that Capital expenses were highly sensitive to reduction of \$2,134 or \$1,994 higher per district per year.

Conclusion

Policymakers and donors should integrate recurring costs into budgets and explore cost-saving strategies like virtual tools or streamlined meetings to improve sustainability. Future research must assess long-term integration into government programs and test alternative approaches across diverse low-resource settings to guide scaling.

Key Words

Implementation Cost, Audit and Feedback, Implementation Strategies, Health Systems Research, Global Health, Primary Health Care, Mozambique

4.2 BACKGROUND

Global efforts to reduce preventable mortality among women and children remain central to achieving the 2030 Sustainable Development Goals (SDGs), as these interventions directly impact current and future population health(78). In Mozambique, the Ministry of Health (MoH) has developed and implemented various evidence-based maternal, newborn, and child health (MNCH) guidelines across more than 1,000 primary healthcare facilities, providing basic maternal and child health services free of charge or at a reduced cost (79). Despite these efforts and high service coverage (>95% antenatal care attendance, 75% facility-based deliveries, and 80% child immunization coverage) (80), high under-five and maternal mortality persist (48,81,82).

Implementation science bridges the gap between research evidence and real-world practice by developing contextually relevant strategies to implement proven interventions (83). A common strategy used in implementation science is audit and feedback (A&F), which improves clinical practice through three key steps: measuring performance against standards, comparing results to benchmarks, and delivering targeted feedback to drive improvement (63,64,84). While systematic reviews demonstrate that previous A&F research has primarily targeted physicians and clinical teams in high-income settings (64), research is limited on A&F models that target clinic-level performance, as well as on A&F in low and middle-income countries (LMICs).

Although costing studies and economic analysis are increasingly conducted in implementation research there is a lack of data on the financial and economic costs of implementing an A&F strategy in LMICs (10,11,85). Understanding the costs of implementing A&F strategies is essential for decision-making and planning to scale and sustain these improvement approaches, many which are funded by external aid. Cost estimates can serve as inputs for cost-effectiveness analyses and budget impact analyses to evaluate the efficiency and affordability of implementation. This study's objectives are to estimate the total implementation cost and cost per intervention components of A&F model that targeted clinic-level performance in Mozambique and compare its total financial cost against district health budgets.

4.3 METHODS

The Integrated District Evidence-to-Action (IDEAs) Program

The Integrated District Evidence-to-Action (IDEAs) program was a system-level (facility and district focused) A&F strategy implemented in central Mozambique from 2016 to 2020 that adapted best practices from the A&F literature (86). Unlike traditional clinician-focused A&F models common in high-income countries (9,10,12), IDEAs focused on health facility performance with districts coordinating and providing feedback for health facilities in their catchment. The program featured regular performance audits linked to facility and system-level indicators, with feedback delivered through a structured process involving frontline supervisors from participating health facilities as well as district and provincial health teams. This approach was used clearly defined, priority-aligned targets coordinated with Ministry of Health (MoH) guidelines (87) and was complemented by supportive supervision and financial support. IDEAs was implemented in partnership with *Comité para Saúde de Moçambique*, a Mozambican non-governmental organization that supported MoH staff with IDEAs implementation.

IDEAs consisted of a multi-component program that involved three key cyclical steps repeated every six months (see Figure 1). The first step, facility and district readiness assessments, assess health facility readiness including staffing; availability of essential medicines, equipment and supplies; and data quality. This step was contracted with a local organization. Second step, A&F meetings, held at the district-level, brought together facility based maternal and child health (MCH) managers, nurses, and district/provincial teams (averaging 29 participants) to review performance and create action plans. Following this, the third step was targeted at facility support from the district using IDEAs-supplied financial assistance to help chosen facilities implement their action plans and provide supportive supervision by district and provincial health teams. The IDEAs implementation process was cyclical and iterative repeated every six months (Figure 1).

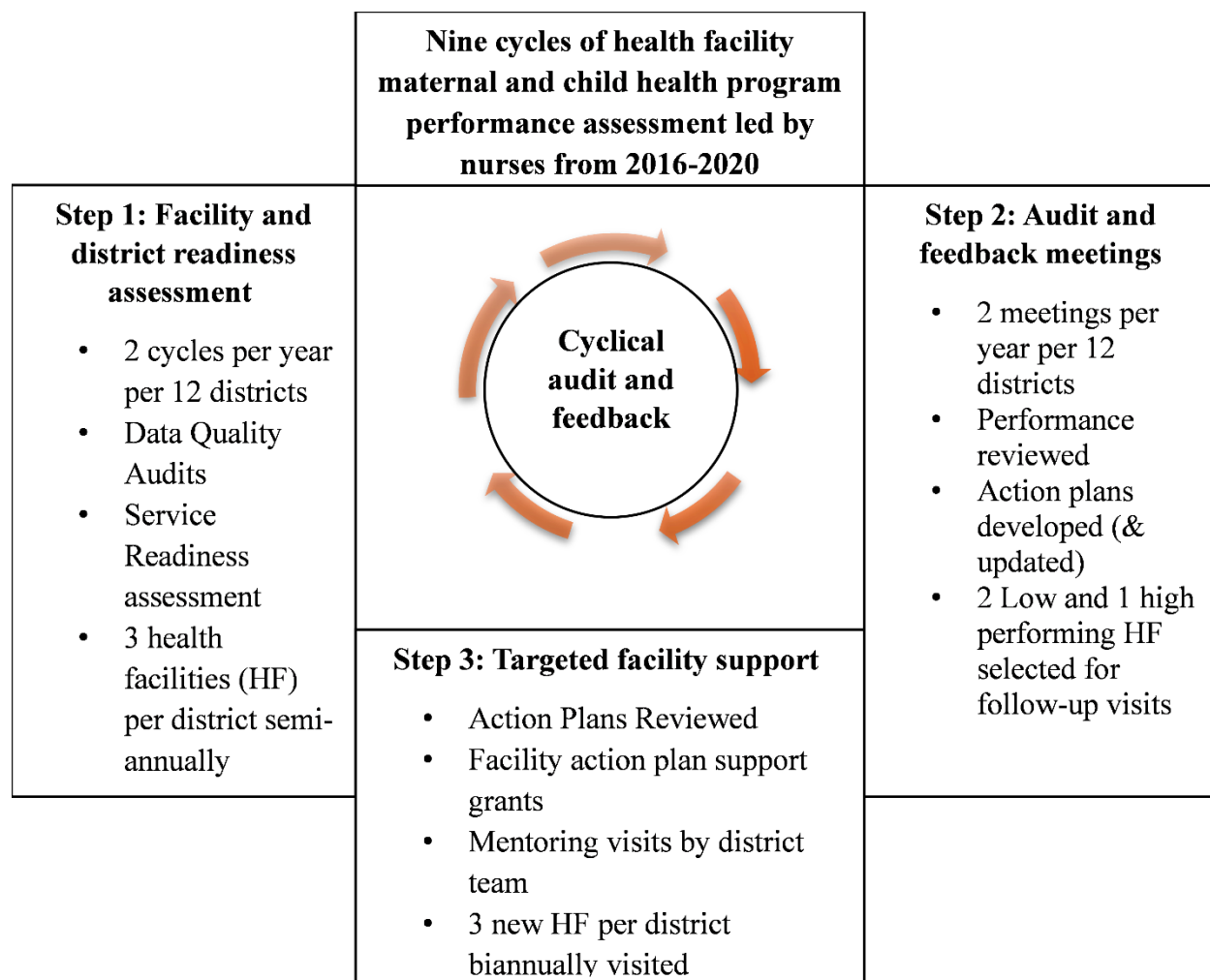


Figure 1: IDEAs program overview. Reprinted with permission from Dinis et al © 2023(86)

Study setting

Mozambique is comprised of eleven provinces, the highest level of administrative divisions. Each province is comprised by multiple districts (88). According to the 2017 Mozambique population and housing census, the population was 28.8 million (88). There are over 1,500 health facilities in Mozambique, with 96% providing primary health care (89). IDEAs was implemented in Sofala and Manica provinces, from 2016 to 2020 covering a total of 12 higher population districts and 154 health facilities, (see Appendix A for map) (86). These provinces have a combined population of over 4 million.

Study Design

We conducted a cost analysis of the IDEAs program from the Ministry of Health (payer) perspective following the Consolidated Health Economic Evaluation Reporting Standards (CHEERs) guidelines (90) (see checklist in Appendix B). Costing followed a mixed-method approach using gross- and micro-costing. We used activity-based gross costing to understand aggregated, high-level costs using a top-down approach for each of the core activities within IDEAs. We chose gross costing since one of the activities in IDEAs (step 1: facility and district readiness assessment) was contracted out and did not have detailed financial information on inputs. We used activity-based microcosting for the other two activities in IDEAs (step 2 and 3), where we had input-level data (91,92).

Cost Categories and Costing Approaches

Costs were annualized over 5 years of useful life (2016-2020), reported in 2020 US dollars. Capital costs were annualized, assuming five years of useful life at a discount rate of 3% (20). Program overview data were sourced from study team. Project expenditure reports were prepared by *Comité para Saúde de Moçambique*. Surveys related to programmatic implementation were collected and stored in Redcap™ (70). Detailed cost assumptions can be found in Appendix C.

Gross Costing: Using a top-down approach, costs for the three core areas of activities (facility and district readiness assessment, A&F meetings, and targeted facility support) were aggregated using program expenditure data, which were divided by the number of intervention districts ($n = 12$) (93). In addition, we estimated total training and intervention operational management costs, aggregated and divided by district. Using the annual expenditure reports, we categorized activities into activity, capital, and “other”. For activity allocation, we created subgroups based on whether the activity involved district meetings, facility and district readiness assessments, targeted facility supports supervision, activity operation, or training. To estimate average annual cost per district, we aggregated actual costs by year and intervention activities across all intervention districts ($n=12$), then discounted to 2020 USD at a 3% annual rate (94). We divided these discounted estimates by twelve to determine the average annual cost per district for each intervention component.

Microcosting: Two of the three core IDEAs activities (A&F meetings and Targeted facility support) had granular level inputs that we used to estimate activity costs and cost drivers for these two activities using a bottom-up approach (93). Activity inputs were classified as accommodation, consultancy, equipment and supplies, food, overhead, per diem, personnel, transportation, venue, or other. The third activity, targeted facility support, was classified in two categories within it that we call supportive supervision and district support.

Staff Time Estimates and Costs: We retrospectively estimated staff time for IDEAs Steps 2–3 (A&F meetings and supportive supervision). While the program was implemented as one initiative, as mentioned above the readiness assessments (Step 1) were conducted by an external contractor that did not provide detailed records of staff involvement or hours worked for this component. For the remaining activities, we worked directly with the IDEAs program team to identify participating personnel and their roles, then calculated annual hours using attendance records and position-specific time allocations.

Comparison Against District Health Budget: We based our district health budget estimate on Mozambique's 2019 UNICEF annual budget brief report, which reported 6.5 billion Meticaïs for district health spending (95). The 2020 report (96) showed a 7% budget increase from 2019 but did not list the total amount. Using this percentage, we adjusted the 2019 figure (6.5 billion Meticaïs) with 7% increase to get the 2020 allocated budget and divided it by for district health. We divided these 2020 district health budget by Mozambique's 180 districts to get an approximate annual health budget per district, which we used to contextualize IDEAs program annual per district costs against standard district health expenditures.

Outcome Measures

The primary outcome was the average cost per district for each intervention area. The average district consisted of 12 primary care facilities. We also aggregated these costs to estimate the total average annual cost (based on calendar years). We differentiated between capital and recurrent costs, reporting all figures in 2020 US dollars, and calculated the average annual expenditure for each category per

district. We then used this total cost per district in 2020 USD to compare against a standard district health budget as indicated above.

Sensitivity Analysis

We conducted a one-way or deterministic sensitivity analysis to identify which parameters have the most significant impact on the overall cost, results were visualized using tornado diagram (85). The length of each bar reflects the extent of cost variation, with longer bars having higher sensitivity. We applied a standard 25% increase or decrease to selected parameters to assess sensitivity.

Scenario Analysis

We conducted scenario analysis to evaluate the potential cost for different delivery options (see Table 1). The cost structure for each scenario was calculated based on yearly expenses per district (using 2020 US dollars).

Table 11: Different IDEAs implementation scenarios

Activity / Scenario	(1) Full IDEAs	(2) Remove readiness assessments	(3) Remove cash transfers & assessments	(4) Remove training, district cash & assessments
Facility/District Readiness Assessments	•	X	X	X
A&F Meetings	•	•	•	•
Supportive Supervision	•	•	•	•
Targeted Facility Cash Transfers	•	•	X	X
District Cash Support	•	•	•	X
Training Components	•	•	•	X

Key:

• = Included in scenario
X = Excluded in scenario

Ethics Statement:

The study was approved by the institutional review board of the University of Washington

(IRB#STUDY00003926), Mozambique's National Bioethics Committee for Health (CNBS-IRB00002657),

and the Ministry of Health after endorsement from Manica and Sofala Provincial Health Directorates. Mozambique's National Bioethics Committee for Health waived the need for informed consent.

4.4 RESULTS

Between 2016-2020, there were a total of nine IDEAs cycles. By 2017 (year 2), the program reached full implementation of A&F meetings (100% of target), while facility participation remained consistently high at 97-98% annually. Over the five-year period, the program maintained an average of twelve participating facilities per district for A&F meetings each year, while support visits averaged 4.7 per district (Table 1).

Table 12: Overview of IDEAs core program implementation activities between 2016-2020

Implementation Period	Step 1: Facility and District Readiness Assessment (N=36 HF/yr)	Step 2: Facilities Participating in A&F Meetings (N= 154 HF/yr)	Step 3: Targeted Facility Support (N=72 HF visits/yr)
2016: n (%)	0 (0%)	124 (80.5%)	10 (13.9%)
2017: n (%)	13 (36.1%)	149 (96.8%)	49 (68.1%)
2018: n (%)	36 (100%)	150 (97.4%)	61 (84.7%)
2019: n (%)	36 (100%)	151 (98.1%)	87 (120.8%)
2020: n (%)	36 (100%)	151 (98.1%)	76 (105.6%)
Total (2016-2020)	121	154	283
Annual average per district: Mean (SD)	2.0 (1.39)	12 (0.98)	4.7 (2.5)

HF = Primary care health facility

For A&F meetings there was variation in the roles represented; however, the core team members consistently included the following: Provincial Head of the Maternal and Child Health Program, District Head of the Maternal and Child Health Program, Facility Head of the Maternal and Child Health Program, Facility Maternal and Child Health Nurse, and District M&E Officer. For targeted facility supervision, the core staff from the district who traveled to the facilities included the following: District Head of Health, District Head of Maternal and Child Health, District Head of PMTCT and a Driver.

Cost Results

The total estimated cost of the IDEAs program from 2016 to 2020 was \$2,224,341 (2020 USD), with most \$1,702,648 (77.0%) spent on recurrent costs, and \$495,323 (22.0%) spent on capital costs with the remaining on staff time costs. Each district had an average cost of \$41,967, including \$28,438 (68.0%) for recurrent expenses and \$8,255 (20.0%) for capital expenses and \$5,274 (13.0%) for staff time.

Of the \$41,967 average annual IDEAs program cost per district, A&F meetings accounted for \$10,893 (25.9%), with participant per diems representing 52.0% of this cost. Capital expenditures totaled \$8,255 (20.0%), primarily for vehicle purchases. Targeted support costs were divided between district-level allocations (\$5,700 or 13.6%, with most of this amount spent for action plan cash transfers) and facility supervision (\$3,623 or 8.6%, mostly for accommodation costs). Facility and district readiness assessment cost were \$6,351 (15.1%). All figures are presented in 2020 US dollars. Annual variations reflected implementation phases: 2016 (start-up) showed minimal costs during initial rollout, 2017-2019 demonstrated full implementation with stable expenditures, while 2020 saw reduced activity due to COVID-19 restrictions (See Fig 2).

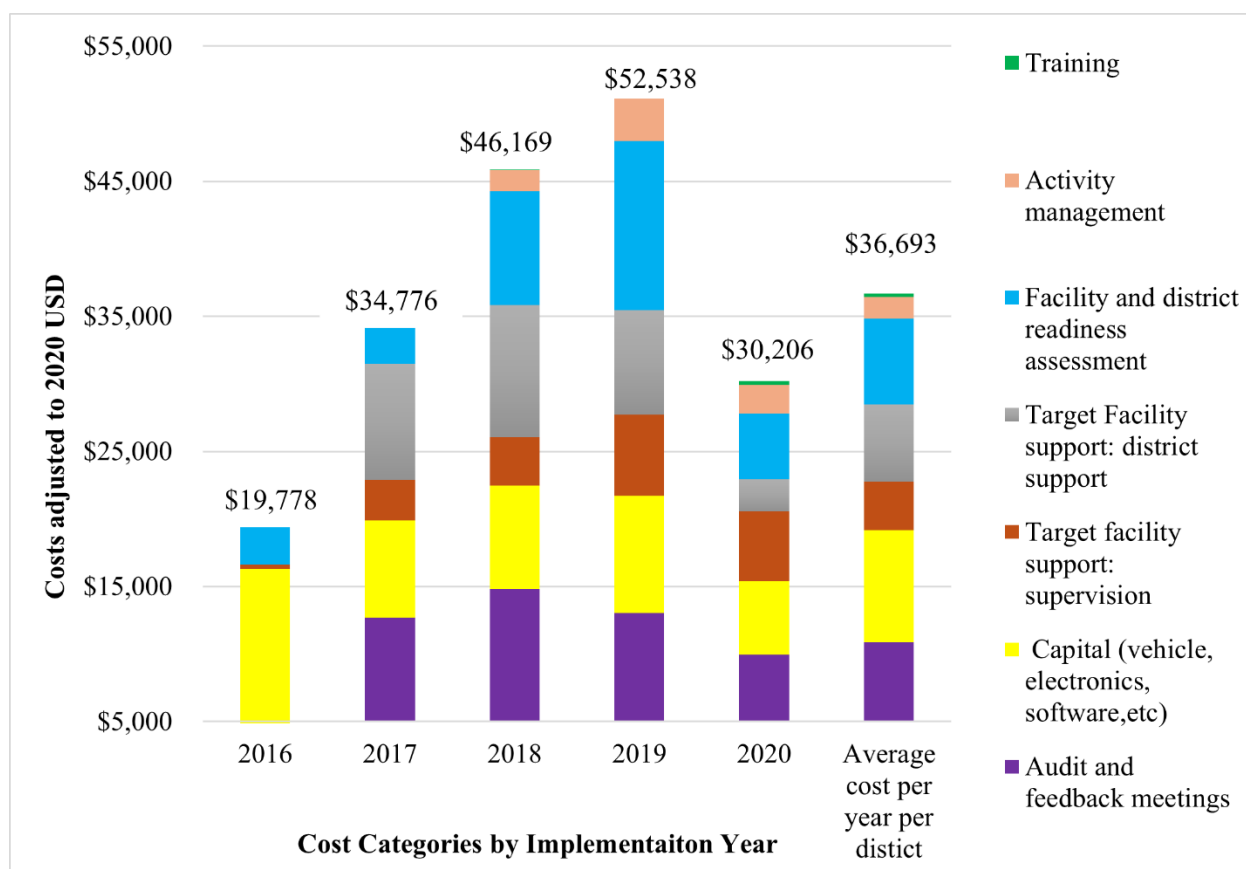


Figure 2: Breakdown of annual discounted costs per intervention activities for an average district without staff time included (annual actual breakdown of staff time not available).

Staff Time Estimates

A&F meetings involved an average of 29 participants per district, including representatives from health facilities, district health management teams, and provincial health management teams. In terms of staff time, the total staff time needed for A&F meetings was 2,320 hours annually for all participants, with an inflation-adjusted cost of 317,173 Meticaïs (\$4,564 USD). Targeted facility support involved four staff members and 240 hours per district for all participants, costing 54,102 Meticaïs (\$710 USD). Combined, these activities involved a total of thirty-three staff members, 2,560 hours, and cost 371,275 Meticaïs (\$5,274 USD) per district annually (Table 2).

Table 13: A&F meetings and Targeted Facility Support Staff Time and Cost Estimates

Activity	Number of Staff	Total Hours per Year (per district)	Inflation-Adjusted Total Cost (2020 Meticaïs)	Total Cost per Year (2020 USD)
Step 2: A&F Meetings	29	2320	317,173	\$ 4,564
Step 3: Targeted Facility Support	4	240	54,102	\$ 710
Total	33	2560	371,275	\$ 5,274

IDEAs Program Costs Compared to Average District Health Budget

The average 2020 district health budget totaled \$634,986 according to UNICEF estimates. The IDEAs program's annual cost of \$41,967 per district represented 6.6% of this standard health budget for districts averaging 12 health facilities.

Sensitivity Analysis

When considering implementing the IDEAs program, if we apply a standard 25% increase or decrease to selected parameters (Figure 3), we found that Capital expenses are highly sensitive to reduction or increase ranging from \$28,286 to \$32,414, followed by the Readiness assessment consultant fee and per

diems for A&F meetings. In contrast, Training exhibits minimal variation, suggesting its minimal effect on overall cost fluctuations.

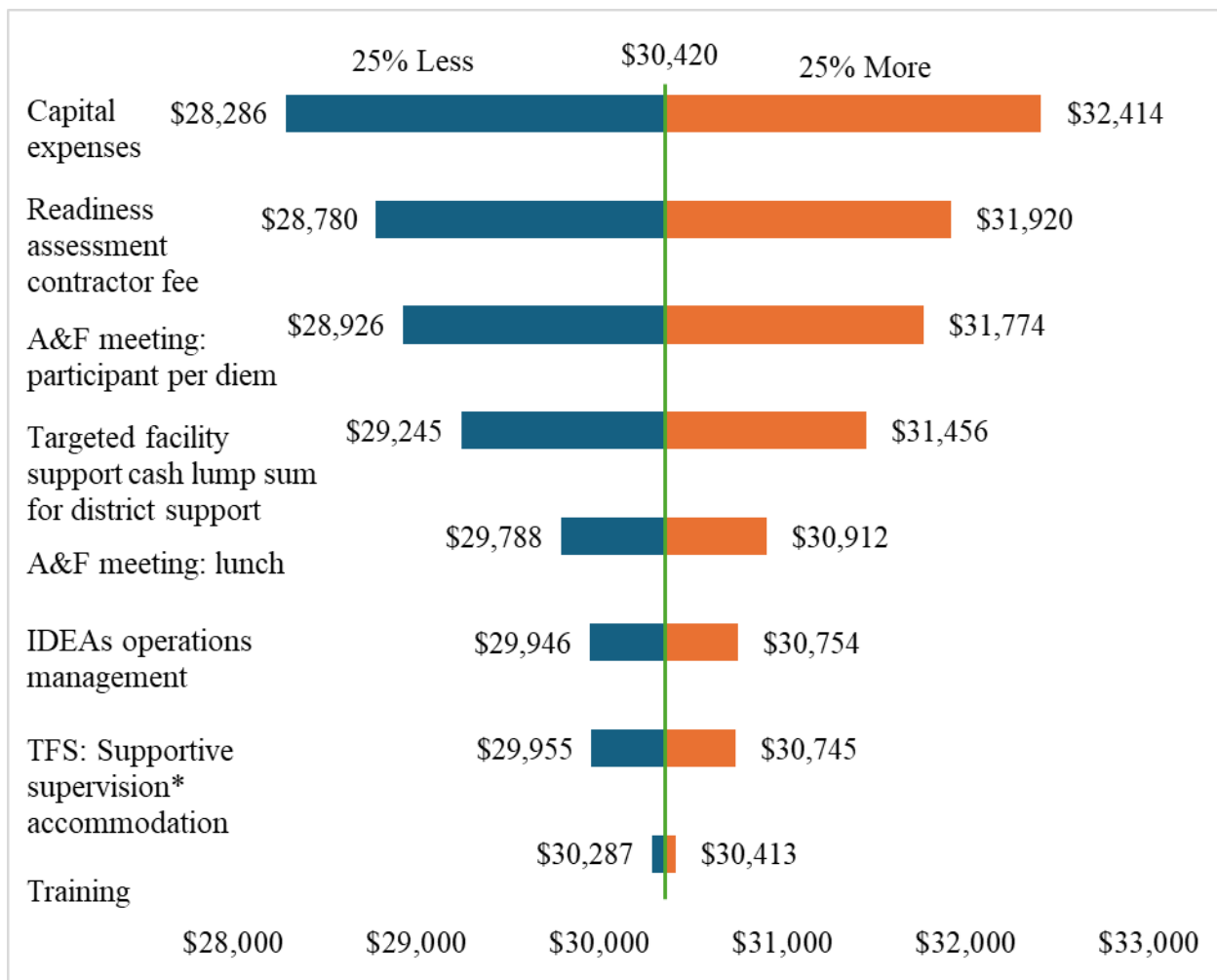


Figure 3: Tornado Diagram for Sensitivity Analysis. Parameters included in this analysis are picked either if their main cost driver identified during microcosting, or other cost parameters included in gross costing.

Scenarios

Below we present results from different implementation scenarios and costs associated with it. Scenario one, which incorporates all components, costs \$36,693. Scenario two excludes the readiness assessment component as mentioned above, reducing costs to \$30,341 (a \$6,352 decrease). Scenario three further removes district support alongside readiness assessment, bringing costs down to \$24,641 (a \$12,052 reduction from Scenario 1). The different breakdowns are shown in Figure 4 below.

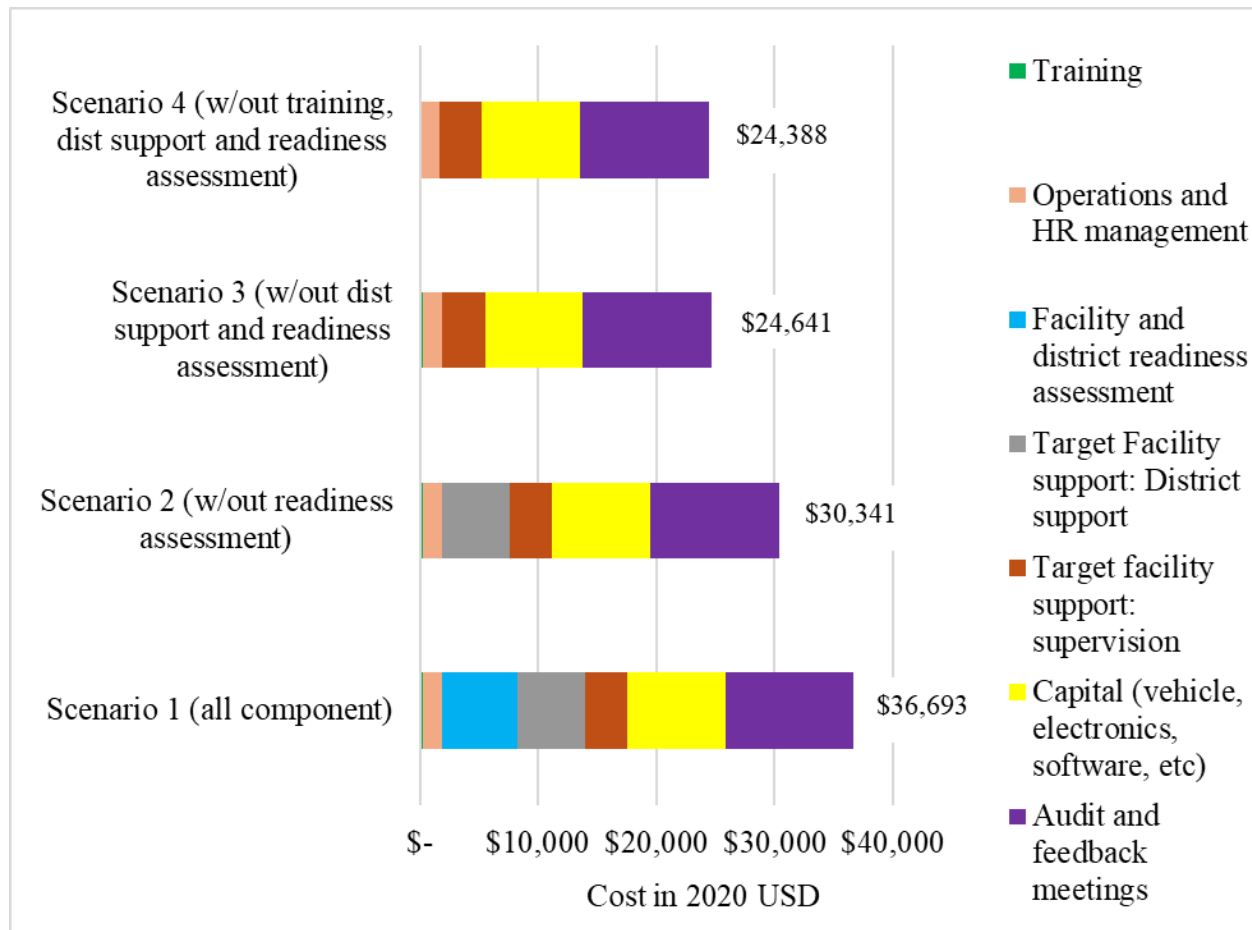


Figure 4: Cost Comparison of Alternative IDEAs Program Implementation Scenarios

4.5 DISCUSSION

The IDEAs program demonstrated the feasibility of integrating a modified A&F strategy into existing government health systems without requiring additional personnel. The program's costs were primarily driven by recurring expenses, such as per diems, food, and accommodation, which accounted for a significant proportion of total expenditures. Despite these costs, the use of existing staff and alignment with government-led primary health care activities highlight the program's potential sustainability and scalability. This study provides a detailed costing analysis of a system-level, A&F intervention, combining gross-costing and microcosting approaches to capture both financial and economic costs in resource limited settings. Our estimates offer valuable insights for policymakers on resource allocation, particularly regarding recurrent activities like supervision and meetings.

Key Cost Drivers

The average annual cost of implementing the IDEAs intervention was \$41,966 per district, representing approximately 6.6% of annual standard district budgets. A more detailed breakdown of district health budgets would have better informed decision-makers by enabling comparisons across specific cost categories, rather than relying solely on broader annual budget figures. Key cost drivers included per diems for A&F meetings (averaging two weeks annually) and district-level grants for facility supervision (1.5 weeks annually). Sensitivity analyses highlight capital expenses, readiness assessments, and per diems as the most influential parameters, providing decision-makers with adaptable scenarios (e.g., phasing out lump-sum support or leveraging existing health information systems).

The Ministry of Health could lower costs by: (1) reducing A&F meeting participants to cut per diems; (2) substituting supervision grants with routine monitoring or affordable incentives; and (3) minimizing facility supervision through staff reductions or other program partnerships.

Comparison with Other A&F Interventions

A comparable intervention in Kenya, involving training, supervision, and face-to-face meetings, cost \$28,250 per hospital over 18 months (97). This intervention, with an average of 32 health workers receiving both initial and follow-up training, cost an average of US\$12,417 (44%). Local facilitator costs for supportive supervision were US\$5,698 (20%), and other facility-based supervision costs were US\$10,136 (36%), resulting in a total implementation cost of US\$28,250 per hospital for 18 months. While direct comparisons are limited due to differences in staff time inclusion and scope, both studies underscore the significant costs associated with in-person meetings and supervision.

While there are limited economic evaluation studies of A&F from LMICs, several studies from high-income countries have evaluated the costs of implementing A&F meetings. We identified a couple of such studies from these settings. In Quebec, Canada, a hypothetical A&F intervention in 57 trauma centers cost \$1.48 million over five years, with an incremental cost-effectiveness ratio (ICER) of \$160 per low-value practice

avoided (98). A study in North Carolina de-implementing unnecessary glucose monitoring reported total A&F costs of \$16,775 over 12 months and \$22,967 over 27 months for 20 clinics(99). In this same study, non-site-based costs were \$14,374 for 12 months and \$17,565 for 27 months, driven by data programming and coding updates. Site-based costs were lower, totaling \$2,401 and \$5,402, respectively. In these studies, cost drivers were mainly technical or product-related, unlike in our study, where per diem, supervision, and cash support for action plans were the main expenses.

Strengths and Limitations

Economic evaluations of A&F interventions in sub-Saharan Africa (SSA) remain scarce; our study helps address this gap, contributing to the limited evidence base for LMICs. We provide information on the cost of implementing a system-level A&F strategy in an LMIC, using real-world data from routine service delivery. We used program expenditure reports, staff interviews, and publicly available reports to develop a comprehensive cost assessment. We applied a mixed costing method that combined top-down and bottom-up approaches. This allowed us to estimate costs for all core program components and provide detailed input-based cost calculations where reliable data were available. Scenario and sensitivity analyses were conducted to explore how changes in key cost drivers could affect total implementation costs. Overall, our findings offer practical guidance for district-level planners considering how to adapt and scale IDEAs. Also, to our knowledge this is the first costing study of an A&F strategy in Mozambique's primary care settings, where other studies could use our estimates for reference.

However, there are limitations. Limited cost disaggregation, especially for readiness assessments (Step 1), may have led to underestimation. However, we attempted to account for costs related to readiness assessments through overall contract payments. Expenditure data may have excluded indirect costs, and recall bias could have affected staff time reporting. The generalizability of findings is limited to contexts with similar health systems. Cost comparisons would be more useful if detailed district budgets were available to provide better context on the added cost of IDEAs. Further breakdowns by catchment population, number of facilities, and staffing could improve the relevance and accuracy of estimates for diverse settings with varying resource availability.

Policy and Research Implications

Policymakers and donors should consider, taking into account recurring costs in routine budgets and exploring cost-optimization or reducing strategies, such as leveraging virtual tools or streamlining meeting structures, to enhance sustainability. Our cost data could support future cost-effectiveness and budget impact analyses to project health outcomes and costs related to district-level A&F implementation in similar settings. Future research should examine long-term sustainability of integrating such interventions into government-led programs and test alternative implementation approaches across diverse low-resource settings to inform scaling decisions.

4.6 LIST OF ABBREVIATION

A&F: Audit and Feedback

DHMT: District Health Management Team

IDEAs: Integrated District Evidence to Action

ICC: Intraclass Correlation Coefficient

LIMCs: Low- and Middle-Income Countries

MCH: Maternal and Child Health

MOH: Ministry of Health

SDI: Service Delivery Indicators

SARA: Service Availability and Readiness Assessment

STROBE: Strengthening the Reporting of Observational Studies in Epidemiology

sSA; Sub Saharan Africa

VIF: Variance Inflation Factor

WHO: World Health Organization

Declarations

Ethics Statement

The study was approved by the institutional review board of the University of Washington (IRB#STUDY00003926), Mozambique's National Bioethics Committee for Health (CNBS-IRB00002657), and the Ministry of Health after endorsement from Manica and Sofala Provincial Health Directorates. Mozambique's National Bioethics Committee for Health waived the need for informed consent.

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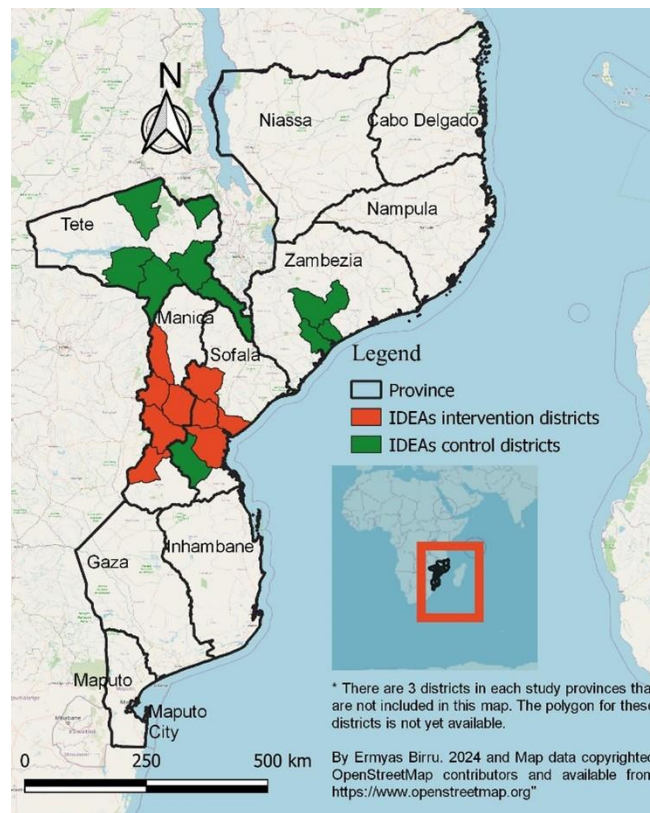
Competing interests

The authors declare no competing interests.

Availability of data and materials

All data can be accessed either in the manuscript text or in the supplementary materials.

4.7 SUPPLEMENTAL



S1 Fig. IDEAs study districts in Mozambique

S1 Table. CHEERS guideline

Section/Item	Item No.	Recommendation	Reported on page No/line No
Title and abstract			
Title	1	Identify the study as an economic evaluation or use more specific terms such as “cost-effectiveness analysis”, and describe the interventions compared.	72
Abstract	2	Provide a structured summary of objectives, perspective, setting, methods (including study design and inputs), results (including base case and uncertainty analyses), and conclusions.	73 and 74
Background and objectives	3	Provide an explicit statement of the broader context for the study. Present the study question and its relevance for health policy or practice decisions.	75
Methods			
Target population and subgroups	4	Describe characteristics of the base case population and subgroups analyzed, including why they were chosen.	76-77
Setting and location	5	State relevant aspects of the system(s) in which the decision(s) need(s) to be made.	77-78
Study perspective	6	Describe the perspective of the study and relate this to the costs being evaluated.	78

Comparators	7	Describe the interventions or strategies being compared and state why they were chosen.	78
Time horizon	8	State the time horizon(s) over which costs and consequences are being evaluated and say why appropriate.	78
Discount rate	9	Report on the choice of discount rates used for costs and outcomes and say why appropriate.	78
Choice of health outcomes	10	Describe what outcomes were used as the measure(s) of benefit in the evaluation and their relevance for the type of analysis performed.	NA
Measurement of effectiveness	11a	Single study-based estimates: Describe fully the design features of the single effectiveness study and why the single study was a sufficient source of clinical effectiveness data.	NA
	11b	Synthesis-based estimates: Describe fully the methods used for identification of included studies and synthesis of clinical effectiveness data.	NA
Measurement and valuation of preference-based outcomes	12	If applicable, describe the population and methods used to elicit preferences for outcomes.	79
Estimating resources and costs	13a	Single study-based economic evaluation: Describe approaches used to estimate resource use associated with the alternative interventions. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost. Describe any adjustments made to approximate to opportunity costs.	78-79
	13b	Model-based economic evaluation: Describe approaches and data sources used to estimate resource use associated with model health states. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost. Describe any adjustments made to approximate to opportunity costs.	NA
Currency, price date, and conversion	14	Report the dates of the estimated resource quantities and unit costs. Describe methods for adjusting estimated unit costs to the year of reported costs if necessary. Describe methods for converting costs on a common currency base and the exchange rate.	79
Choice of model	15	Describe and give reasons for the specific type of decision- analytical model used. Providing a figure to show model structure is strongly recommended.	NA
Assumptions	16	Describe all structural or other assumptions underpinning the decision-analytical model.	78 and S2 Table
Analytical methods	17	Describe all analytical methods supporting the evaluation. This could include methods for dealing with skewed, missing, or censored data; extrapolation methods; methods for pooling data; approaches to validate or make adjustments (such as half cycle corrections) to a model; and methods for handling population heterogeneity and uncertainty.	78-79
Study parameters	18	Report the values, ranges, references, and, if used, probability distributions for all parameters. Report	80

		reasons or sources for distributions used to represent uncertainty where appropriate. Providing a table to show the input values is strongly recommended.	
Results			
Incremental costs and outcomes	19	For each intervention, reports mean values for the main categories of estimated costs and outcomes of interest, as well as mean differences between the comparator groups. If applicable, report incremental cost-effectiveness ratios.	82
Characterizing uncertainty	20a	Single study-based economic evaluation: Describe the effects of sampling uncertainty for the estimated incremental cost and incremental effectiveness parameters, together with the impact of methodological assumptions (such as discount rate, study perspective).	NA
	20b	Model-based economic evaluation: Describe the effects on the results of uncertainty for all input parameters, and uncertainty related to the structure of the model and assumptions.	NA
Characterizing heterogeneity	21	If applicable, report differences in costs, outcomes, or cost-effectiveness that can be explained by variations between subgroups of patients with different baseline characteristics or other observed variability in effects that are not reducible by more information.	82-86
Discussion			
Study findings, limitations, generalizability, and current knowledge	22	Summarize key study findings and describe how they support the conclusions reached. Discuss limitations and the generalizability of the findings and how the findings fit with current knowledge.	86-89
Other			
Source of funding	23	Describe how the study was funded and the role of the funder in the identification, design, conduct, and reporting of the analysis. Describe other non-monetary sources of support.	91
Conflicts of interest	24	Describe any potential for conflict of interest of study contributors in accordance with journal policy. In the absence of a journal policy, we recommend authors comply with the International Committee of Medical Journal Editors recommendations.	91

S2 Table. Cost Assumptions

Cost Component	Assumption/Parameter	Source
Timeframe	5 years (2016–2020)	Program Budget Data
Number of Facilities	154 facilities	Program Records
Total Cost	Aggregated costs across all activities over the 5-year period.	Program Budget Data
Activities	Audit and Feedback Meetings, District Support, Supervision	Program Design

Average Cost Per Year	Annualized total cost by intervention. Fiscal year for annual estimates are from April to March months	Calculated from total budget
Audit & Feedback Costs	Includes costs of meetings, materials, and logistics.	Program Budget Data
District Support Costs	Includes travel, materials, and support for district-level interventions	Program Budget Data
Supervision Costs	Includes direct costs for supervision visits and follow-up.	Program Budget Data
Average Cost Per Facility (Year)	Total cost divided by 154 facilities and 5 years.	Calculated from total budget
Audit & Feedback: Cost Per District (Year)	Average annual district cost for audit and feedback	Calculated from activity data
District Support: Cost Per District (Year)	Average annual district cost for district support.	Calculated from activity data
Supervision: Cost Per District (Year)	Average annual district cost for supervision.	Calculated from activity data
Audit & Feedback: Cost Per Facility (Year)	Annual cost per facility for audit and feedback meetings.	Calculated from activity data
Audit & Feedback: Cost Per Person (Year)	Range based on participant numbers and annual costs.	Calculated from activity data
Travel Costs	Included under district support and supervision. Assumes travel was necessary for district and supervisory activities.	Program Budget Data
Inflation Adjustment	Not applied. Costs are nominal and unadjusted for inflation.	Research Assumption
Geographic Scope	Thirteen districts in Mozambique.	Program Records

S3. Table. Staff time estimates

Activity	Role	Number of Staff	Hours per Year per Person	Total Hours per Year (per district)	Total annual FTE hours in terms of monthly working	Total annual FTE hours in terms of monthly working	Monthly Salary (Meticais)	Total Cost per Year (2019 Meticais)	Inflation-Adjusted Total Cost (2020 Meticais)	USD to Meticais exchange Rate (2019)	Exchange Rate to USD (2020)	Average annual staff time cost in USD (2019 USD)	Total Cost per Year (2020 USD)
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					g hou rs per son	g hou rs							
IDEA Audit and Feed back Meeti ngs (n=29)	Sub total	29	560	232 0	3.5	14.5	189,822	306, 447	317, 173	60.8 5	69.5	\$5,4 67.2 4	\$ 4,56 3.63
	Prov incia l hea d of MC H	1	80	80	0.5	0.5	37,338	18,6 69	21,0 69	60.8 5	69.5	\$ 306. 81	\$ 303. 15
	Prov incia l hea d of PMT CT	1	80	80	0.5	0.5	37,338	18,6 69	21,0 69	60.8 5	69.5	\$ 306. 81	\$ 303. 15
	Distr ict hea d of MC H	1	80	80	0.5	0.5	27,078	13,5 39	10,2 25	60.8 5	69.5	\$ 222. 50	\$ 147. 12
	Distr ict hea d of PMT CT	1	80	80	0.5	0.5	27,078	13,5 39	10,2 25	60.8 5	69.5	\$ 222. 50	\$ 147. 12
	Facil ity hea d of MC H	12	80	960	0.5	6	23,473	140, 838	122, 697	60.8 5	69.5	\$2,3 14.5 1	\$ 1,76 5.42
	Facil ity MC	12	80	960	0.5	6	19,758	118, 548	122, 697	60.8 5	69.5	\$1,9	\$ 1,76 5.42

	H nurse											48.20	
	District M&E officer	1	80	80	0.5	0.5	17,758	8,879	9,190	60.85	69.5	\$ 145.92	\$ 132.23
	Sub total	4	240	240	1.6	1.6	150,715	52,272	54,102	60.85	69.5	\$ 990.73	\$ 710.24
	Provincial head of MCH	1	60	60	0.4	0.4	37,338	14,935	16,856	60.85	69.5	\$ 245.44	\$ 242.53
	District head of health	1	60	60	0.4	0.4	74,848	29,939	24,326	60.85	69.5	\$ 492.02	\$ 350.01
	District head of MCH or PMTCT	1	60	60	0.4	0.4	27,078	10,831	8,180	60.85	69.5	\$ 178.00	\$ 117.70
	Driver	1	60	60	0.4	0.4	11,450	4,580	4,740	60.85	69.5	\$ 75.27	\$ 68.20
Total		33	800	2560	5.1	16.1	340,536.20	358,719	371,275	60.85	69.5	\$6,457.96	\$ 5,273.87

CHAPTER 5. CONCLUSION

5.1 CONCLUSION AND FUTURE RESEARCH

This dissertation assessed the effect of different implementation strategies on primary health care (PHC) services using multimodal implementation research in sub-Saharan Africa (sSA). We systematically reviewed implementation strategies for evidence-based management interventions among PHC managers in sSA (Aim 1), assessed the effectiveness of management training and the IDEAs system-level A&F strategy in improving service readiness in Mozambique's public PHC settings (Aim 2), and analyzed the cost of implementing a system-level A&F strategy (IDEAs) in central Mozambique (Aim 3). The approaches taken in this study demonstrated the application of theory-driven, systematic, and multidisciplinary methods from the fields of management theory and economics.

In Aim 1, the systematic review highlighted few studies from sSA that showed effective implementation of evidence-based management interventions along with implementation strategies which indirectly influence PHC services. Considering management as a core component of the health system's leadership and governance building block, we learned that there is a lack of studies showing interventions and strategies aimed at enhancing PHC managers' capacity. Therefore, there is a need for more reports demonstrating effective interventions for PHC managers in sSA, their implementation outcomes, and their effects on service-level and clinical outcomes.

In Aim 2, using a theory-driven evaluation approach in implementation research, we applied a repeated cross-sectional facility survey design among intervention and matched control districts to study large and diverse groups of healthcare workers. Our findings supported the hypothesis included in the middle manager theory for implementation evidence-based practice, where capacitated primary care managers complemented a system-level A&F strategies to implement national PHC guideline to enhance service readiness. However, further research is needed to evaluate the implementation of innovative strategies for health facility-based evidence-based interventions (EBIs), particularly focusing on how general management skills or training influence implementation effectiveness and other outcomes. Future studies could explore both moderator and mediation analyses to assess how management improve

implementation effectiveness, specifically exploring mechanisms with effective management that enhance uptake of innovation.

In Aim 3, using a mixed-methods costing approach, we described the cost of implementing a system-level A&F strategy in Mozambique. The advantage of the IDEAs program is that it can be implemented with existing staff and resources for PHC programs. The overall effectiveness of the IDEAs study is still under review, but with this costing information, it will be possible to explore different scenarios if the cost of implementing the entire package proves unfeasible. To our knowledge, this is the first such study in Mozambique and one of the few in sSA. Decision-makers, implementers, and researchers can use the results of our analysis to estimate the cost of implementing a system-level A&F strategy in their respective settings.

In conclusion, this dissertation highlighted the need for more implementation research assessing the role of PHC managers in the uptake of evidence-based programs. An area that could be explored further is understanding how a system-level A&F strategy interacts with different types of management training targeting healthcare workers, including managers, in implementing new interventions. This includes evaluating effectiveness in terms of implementation outcomes, service delivery, and population health outcomes, especially understanding maintenance and sustainability following the intervention.

As for theories, models, and frameworks in implementation research, this dissertation contributes to the use of theories in global health implementation research, where there is limited use of theories (100). Maternal and child mortality that can be prevented through effective implementation of existing evidence-based government guidelines can be implemented through approaches used in this study, with the goal of reaching 2030 SDGs health goals. Lastly, given current global health funding and program cuts, building primary care health systems is key to sustainable quality healthcare provision in LMICs (101). We hope this serves as information for local leadership to approach health provision and support from a strong health system perspective.

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