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Untangling the complexities of the implementation journey of health service delivery redesign in Kenya: a mixed-method process evaluation

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Abstract

Background

We documented the implementation experience of a maternal and newborn healthcare reform known as Service Delivery Redesign (SDR) in Kakamega County, Kenya. This redesign aimed at improving maternal and newborn outcomes by reorganizing care delivery to encourage deliveries in facilities capable of providing definitive care during emergencies. Using an implementation science approach, we conducted a process evaluation to assess implementation fidelity, adoption, and sustainability across multiple health system components.

Methods

This mixed methods evaluation used data derived from facility surveys, provider assessments, emergency transport data, financial records, key informant interviews, focus group discussions, and in-depth interviews. We examined governance, financing, human resources, and service delivery aspects.

Results

Implementation success varied across health system components. Political support enabled successful policy development, including the facility improvement fund granting Level 4 facilities financial autonomy. Infrastructure improvements significantly increased bed capacity at Malava (22–39 beds) and Lumakanda (10–26 beds) hospitals, although gaps remained against projected targets (44–68% of long-term needs). The emergency transport system achieved a 90.3% success rate (13,401 of 14,842 cases), with 10–30 minute response times. Emergency Obstetric Care training reached 496 healthcare workers, enhancing their clinical competency. However, complex unintended consequences, including ambulance service misuse, automatic referrals without proper assessment, cultural resistance to ambulance use, diminishing trust in lower-level facilities, and power struggles over financial control, have emerged, creating reinforcing feedback loops that potentially undermine the intervention's intended hierarchical care model.

Conclusion

While SDR has achieved important improvements in maternal healthcare infrastructure, emergency transport, and financial autonomy, significant implementation challenges and unintended consequences highlight the intricate interconnectedness of health system components. These findings underscore the need for comprehensive health system strengthening that addresses all interconnected elements with adequate resources, robust sustainability mechanisms, and adaptive management approaches to achieve sustainable improvements in maternal and newborn healthcare in resource-limited settings.

Background

Global maternal and neonatal health disparities remain stark, with low-income countries experiencing higher mortality rates than high-income nations do. Maternal mortality is 40 times greater, and neonatal mortality is 9 times greater in these regions [1]. Despite international efforts, key health targets have proven challenging to achieve [2]. While countries have improved access to care, these improvements have not translated into proportional reductions in mortality, suggesting the need to fundamentally improve the quality and comprehensiveness of maternal and newborn care [3].

In response to these challenges, the Lancet Global Health Commission on High-Quality Health Systems [4] recommended a large-scale approach to improve equity, quality, and outcomes through service delivery redesign (SDR) for maternal and newborn health. SDR is a process of intentionally reorganizing health systems to optimize outcomes by ensuring that patients receive appropriate care at the right healthcare system level and from the right provider. Specifically, for maternal and newborn health, the SDR seeks to ensure that deliveries take place in a setting where definitive care can be provided in the case of a life-threatening emergency. The goal is to fundamentally improve the quality and comprehensiveness of maternal and newborn care to reduce mortality rates and morbidity [4].

In 2019, the government of Kakamega County, in western Kenya, opted to implement SDR, which focused on increasing the number of women who gave birth in hospitals. The Kakamega Maternal and Newborn Health Service Delivery Redesign aimed at shifting delivery care for all women to advanced facilities that offer definitive care for complications or nearby linked birthing facilities. The primary care facilities provide high-quality antenatal, postnatal, and well-baby care services [5].

The complexity of Kakamega's SDR reform meant that any efforts to understand its effect depended on examining how the dynamic nature of intervention subcomponents interacted to generate the observed outcomes, both intended and unintended [6]. This implementation science analysis assesses the adequacy of intervention implementation and seeks to clarify which change processes contribute to the observed effects, why specific outcomes may not have shifted, and whether the intervention functions as intended within and across the different components of the health system [7].

Crucially, process evaluation can distinguish intervention failure from implementation failure [8]. Intervention failure occurs when the intervention is delivered as intended but does not improve outcomes, indicating that it should not be implemented. In contrast, implementation failure occurs when the intervention is inadequately implemented and may require further research to examine effectiveness, for example, by studying the impact in a different setting in which the program was comprehensively implemented. Various evaluation approaches can be employed depending on the intervention stage and scope, allowing for a comprehensive assessment of complex programs. For example, process evaluations can examine multiple health system components. A governance evaluation component might assess policy development processes, stakeholder acceptance of programs, prioritization across different levels, and the effectiveness of procedures for participation and accountability. A financing-focused evaluation could analyse financial flows, sustainability measures, and how and to what extent

additional funds were allocated for scaling up technologies, infrastructure, and necessary supplies. Within the human resources domain, implementation indicators could include skills training coverage and health worker hiring and deployment. For the remaining subsystems, process evaluation could examine implementation approaches and their impact on service delivery, including factors such as provider motivation and the technical and human dimensions of care quality [7].

We conducted a process evaluation to assess the implementation of the SDR in Kakamega County, focusing on phase 1 of a proposed multiphase program. The specific objectives were to assess the process of implementing the SDR project and to identify the implications of the SDR at the facility and county health system levels.

Methods

Intervention

The Kakamega County Department of Health has been implementing SDR since 2021, with support from a consortium led by Jacaranda Health, a specialized maternal health nonprofit organization operating in Kenya, in partnership with Thinkwell, Thinkplace, and Rescue.co. The programme was introduced through a phased approach to centralize childbirth in hospitals while transforming primary care facilities into high-quality antenatal and postnatal care centres with robust linkages to hospital delivery services [9].

Kenya’s health delivery system is structured from Level 1 to Level 5, comprising communities, dispensaries, health centers, subcount hospitals, and county referral hospitals [10]. Level 4 facilities (subcounty hospitals) and level 5 facilities (county referral hospitals) represent higher-level facilities with the capacity and resources to provide comprehensive emergency obstetric and newborn care, as well as manage both routine and complicated deliveries safely. The SDR programme specifically targeted the centralization of deliveries at these facilities.

The components included strengthening hospital infrastructure, hiring and training clinical staff, updating policy frameworks (including health financing procedures), stimulating community demand, and providing emergency transport.

Prior to the decision to pilot the SDR, a comprehensive feasibility assessment was conducted in 2019, which revealed significant challenges across the maternal healthcare continuum [9]. These included critical gaps such as inadequate emergency transportation options, limited hospital bed capacity, infrastructure deficiencies, and shortages of skilled medical professionals capable of providing timely, high-quality, dignified maternal care. The assessment findings were then discussed with key stakeholders, including the Kakamega County governor, cabinet members, senior health department officials, and the Council of Governors' CEO. These consultations were instrumental in refining the program's design, identifying necessary resources, and developing a strategic implementation plan. The feasibility assessment and design phase was then followed by an improvement phase: when (with

funding from the Bill and Melinda Gates Foundation), the consortium supported the County government in strengthening designated hospitals and the broader health system in preparation for the implementation phase, during which deliveries would be shifted to hospitals in phase 1 subcounties (Malava, Lumakanda, and Butere Sub-County Hospital) is shown in Fig. 1 below.

The SDR implementation process in Kakamega was guided by a theory of change (Fig. 2) that summarized the inputs, activities, outputs, and outcomes during the improvement phase. During this phase, the level 4 hospitals (delivery hubs) improved capacity and readiness for higher patient volumes resulting from the SDR policy change. These capacity improvements were delivered through a series of intervention subcomponents as shown in Fig. 2 in the activities. The implementation also included putting in place support systems such as an SMS information service for pregnant mothers (known as “Prompts”), a peer-to-peer health worker mentorship program, a digital blood tracker at the hubs, health financing improvements, pilot human-centered design interventions at selected facilities, and deployment of additional health providers.

SDR implementation was a partnership between a consortium led by Jacaranda Health and the Kakamega County government. Kakamega SDR relied on political goodwill from Kakamega’s leadership and the recognition of local stakeholders as crucial change agents. The consortium provided health worker training, contracted providers to upgrade facilities (e.g., by expanding maternity wards), and directly provided some specified services such as emergency transport (via Rescue.co) and technical assistance. The county government of Kakamega led the process by deploying additional staff, ensuring the availability of supplies and commodities, funding the programme's recurring costs, and some infrastructure improvements. However, the construction of a new Butere Subcounty Hospital, while undertaken during this period, presented implementation challenges for the SDR rollout in the Butere subcounty.

Study design

We conducted a mixed-method process evaluation guided by the RE-AIM framework [11]. The framework recognizes that interventions act on multiple levels (e.g., individual, health-care provider, community, institutional), and their impact relies on the combined effect on five dimensions: reach (proportion of the population affected by the program); efficacy (positive and negative outcomes of the program); adoption (degree of participation in the program); implementation (the degree to which the program is implemented as intended); and maintenance (institutionalization of the program over time) [11]. The study's qualitative approach aimed at identifying factors that supported or impeded the full implementation of the project, whereas the quantitative approach analysed inputs and outputs from the Kakamega SDR implementation.

Data collection

The data collection strategy was informed by the SDR theory of change. We used quantitative and qualitative data to measure implementation fidelity and identify key obstacles to successful implementation and facilitating factors. We also assessed the possible unintended consequences of the SDR policy on health system functioning.

The quantitative data included facility surveys, provider assessments, emergency transport data, and financial data collected between 2022 and 2024, which measured delivery capacity, structural qualities, and care processes before and after redesign implementation. The population sampled was from three delivery hubs and providers working in maternity or newborn care units. We focused on structural components of facility readiness, including the number of maternity beds, the presence of a newborn unit, the number and functionality of operating theaters, the presence of staff (medical doctors by specialty, clinical officers, nurse-midwives, nurses, and other cadres), the availability of 24-hour care, and the presence of basic and comprehensive emergency obstetric signal functions (procedures, equipment, and medicines).

The emergency transport data are from Rescue Co., which operated the emergency transport system in partnership with the county government. These data included all maternal and newborn emergency calls received and responded to during the period in which Rescue.co was supporting the SDR. Rescue Co. used a standardized reporting system to track call outcomes, response times, and patient status. Permission to use these data was obtained from both Jacaranda Health and Rescue.co.

Qualitative data were drawn from key informant interviews, focus group discussions (FGDs), and in-depth interviews to explore stakeholders' roles and experiences during the implementation of SDR. The participants were recruited purposively to represent the range of stakeholders involved in the project (see Table 1). Eligible participants were informed about the project and the study objectives and signed informed consent before participating. All the interviews and FGDs were conducted in English and Swahili, lasted 30–60 minutes, and were audio recorded. The interviews and FGDs focused on SDR origin, implementation processes, challenges, support structures, impacts across health system components, and both intended and unintended consequences.

The FGD guide was adapted from a previously published study [12], while the key informant interview and in-depth interview guides were developed for this study. English-language versions of all interview and FGD guides are provided as supplementary files (S1-S3).

Table 1
Study participants

Key informant interviews (KII)	**Number interviewed**	**Respondents**
	19	**Frontline Nursing Officer, Medical Officer, County Reproductive Health Services Coordinator, County Community Health Coordinator, County Primary Health Care Coordinator,**
Focus group discussions (FGDs)	2	Men and Birth companions
In-depth interviews	2	1 birth companion, 1 CHV
Interviews with implementing partners	5	Project Manager, Project Lead, and Project Coordinator

Analysis

The interview transcripts were imported into NVivo 12 software for coding in two steps. Using an inductive approach, we obtained a general sense of the narratives and identified the themes and subthemes. In the second stage, we applied a deductive approach, adopting selected components of the RE-AIM framework to fit our themes and subthemes into three main thematic areas: a) adoption (reinterpreted as stakeholder buy-in and acceptance among health workers, county leadership, and communities, rather than the traditional RE-AIM definition of the proportion of settings chosen to participate), b) implementation (implementation fidelity, the degree to which the program was implemented, what changed, and the reasons), and c) maintenance (the sustainability aspect of SDR). We also documented unintended consequences that emerged from the intervention, which, while not traditionally part of RE-AIM, are critical for understanding complex adaptive system responses to health system interventions. The full RE-AIM framework includes reach and effectiveness dimensions; however, this process evaluation emphasized understanding how the intervention was accepted and implemented and sustainability challenges rather than measuring population-level reach or effectiveness outcomes.

The quantitative data-cleaning process involved combining the four rounds of data collection for the facility survey and provider assessments into one file and conducting logic checks to ensure data quality and consistency. Data from Jacaranda Health, Rescue Co., the County Health Department, and facility surveys conducted across four data collection rounds (implemented by Ipsos-Kenya) tracked changes in infrastructure capacity, equipment availability, medical stocks, service utilization, and financial management.

We present descriptive statistics on key facility performance indicators, including the number of dedicated maternity beds across facilities, availability rates of essential medicines and commodities, equipment availability metrics, emergency transport service utilization, revenue collection trends

following the facility improvement fund (FIF) policy implementation, and health workforce distribution by cadre.

The infrastructure capacity was measured by counting dedicated maternity beds at each hub facility against established targets (*refer to the Kakamega feasibility study* [9]). Equipment and supply availability was calculated as the percentage of functional essential equipment items from standardized checklists (*Additional files 3, 4, and 5*). Medicine and commodity stocks (*Additional file 2*) were assessed as the percentage of essential items available on the assessment day, with stock-outs defined as unavailability exceeding 7 consecutive days in the past month.

Emergency transport utilization was quantified through counts of cases transported and response times in minutes. Revenue collection trends were tracked through monthly facility data before and after FIF policy implementation, with performance evaluated against quarterly targets. Health workforce distribution was analysed by counting the number of cadre providers who received Emergency Obstetric and Neonatal Care training.

For the assessment of obstetric care capacity, we used standardized definitions of basic emergency obstetric and newborn care (BEmONC) and comprehensive emergency obstetric and newborn care (CEmONC) [13]. BEmONC was defined as the capacity to perform seven signal functions: administering parenteral antibiotics, administering uterotonic drugs, administering parenteral anticonvulsants for preeclampsia and eclampsia, manually removing the placenta, removing retained products of conception, performing assisted vaginal delivery, and performing basic neonatal resuscitation. CEmONCs are defined as having BEmON capabilities plus the ability to perform cesarean sections and blood transfusions [13].

The mixed-methods approach strengthened our analysis by integrating qualitative perspectives with quantitative measurements. While the interview data revealed stakeholder experiences, implementation challenges, and unexpected outcomes, the quantitative metrics provided measurements of service delivery improvements, resource allocation, and health system performance. This triangulation of data sources validated key findings and highlighted discrepancies between perceived and measured outcomes.

Results

This study describes the service delivery redesign (SDR) implementation process, highlighting achievements, challenges, and unexpected consequences that emerged from this complex health system intervention.

Box 1: Key Political Actors in SDR Implementation

Council of Governors (CoG): Engaged with the County Executive Committee prior to SDR implementation, creating foundational support for the initiative across county leadership.

Governor of Kakamega County: Provided executive endorsement and committed county funding for SDR implementation. His early buy-in created a pathway for implementation with minimal resistance.

County Health Management Team (CHMT): Including the County Executive Committee (CEC) member for Health, Chief Officers, and Directors. Demonstrated ownership and accountability throughout implementation, publicly addressing community concerns and clarifying roles between partners and county government.

Innovation TWG (Technical Working Group): Comprised representatives from CHMT, subcounty CHMT, and project partners (Jacaranda, Rescue. Co, ThinkWell, ThinkPlace). Facilitated coordinated implimantation of the different SDR components.

Sub-County Health Management Teams: Provided ground-level implementation support and participated in TWG decision-making processes, ensuring that facility-level perspectives informed county-wide decisions.

Implementation outcomes varied across the different intervention areas. Four interventions were fully successful: improved transportation systems, community engagement initiatives, the SMS Prompts system, and peer-to-peer mentorship programs. Five interventions achieved partial success: creating a conducive environment through policy development, relocating deliveries to hub facilities, health financing reforms, human-centered design implementation, and boosting primary care services. Two interventions were unsuccessful or discontinued: the digital blood tracker system and planned health worker transfers (Supplementary Table 1). Overall, the implementation achieved full or partial success in nine of the eleven planned intervention areas. The partially successful and unsuccessful components experienced critical gaps in their implementation (Supplementary Table 2), with detailed findings presented in subsequent sections.

Coordination and ownership

The Innovation TWG facilitated well-coordinated health system responses. Bringing all key players together ensured that decisions reflected the collective needs and perspectives of the entire system. As one informant explained,

“We called it the innovation TWG, it gave us good insights because you would send a team out that has a composition of someone from the CHMT, subcounty CHMT, and from the partner and is represented there, you are speaking as the county.”- Respondent 019

Through engagement and collaboration with government and community stakeholders, SDR promoted discussions translated into actionable commitments. Another key respondent noted:

“We found that we (implementing partners) truly worked so well with them (County Health Management Team) that we would go to a discussion and come out with an agreement and yes you would see the commitment to have it fulfilled so that was a great success.”- Respondent 019

The actors implementing SDR fostered a sense of ownership and accountability, which promoted buy-in, mindset shifts, and behavior change. The engagement efforts led to increased acceptance. For example, respondents could report the following:

"I think that ownership from the county health management and the subcounty health management, I think was a big one. And I think seeing them confidently answer questions that were posed by mothers, questions that were posed by fathers, I think that was a big win…I think a healthcare worker said something like, we are understaffed, can you give us more staff? In addition, they came in and clarified and said, it is not the role of partners to staff on SDR. On SDR, it is we, the county, so we are the ones who are failing, but we are working on it and so there was that ownership." Respondent 021

Infrastructure and Service Delivery Transformation

The SDR initiative improved maternal and newborn healthcare infrastructure in certain areas, such as the construction and renovation of maternity wings in both Malava and Lumakanda subcountry hospitals and a newborn unit (NBU) in Malava subcountry hospitals.

These improvements addressed previous space constraints in maternity wards, improving service accessibility compared with the pre-SDR implementation period. At Malava Subcounty Hospital, the old labor ward was renovated into an NBU with a 10-bed capacity to assist with preterm labor cases referred to the hub. Owing to space limitations, the Lumakanda Hub only benefited from renovations and equipment upgrades, which included a holding space with basic life-saving equipment for newborns awaiting referral to the next hub (in contrast to Malava), but not a full newborn unit. In addition, despite the construction of a dedicated maternity theater in Malava Sub-County Hospital, nonoperational and cesarean sections (C-sections) are still conducted in the general theater.

The implementation of the SDR improved dedicated maternity bed capacity across all three phase 1 hub facilities from baseline to November 2023, as illustrated in Fig. 3. However, the maternity capacity of subcountry hospitals (SCH) has remained unchanged (34–35 dedicated beds). This was primarily because Butere's new hospital, which was specifically designed to host the expanded maternal wing, was yet to be completed. In contrast, Lumakanda SCH and Malava SCH showed increases in capacity, from 10 to 26 and 22 to 39 maternity beds, respectively.

Despite these improvements in the number of maternity beds, substantial bed capacity expansion is still needed across all three facilities to meet both immediate and future maternal care requirements when deliveries are shifted to the three facilities.

Figure 4 shows the current maternity bed capacity of each phase 1 hub facility compared with both the near-term and long-term targets established during the 2021 feasibility study [14]. The near-term targets (shown in light blue) represent the bed capacity needed to accommodate 11,217 deliveries that would otherwise occur in level 2/3 facilities being redirected to these three designated hospitals. The long-term

targets (shown in green) represent the capacity required to handle all 17,910 deliveries across the three subcounties, including facility and home deliveries.

Currently, Butere SCH has 34 available beds, with a near-term target of 42 beds (81% of the target) and a long-term target of 65 beds (52% of the target). The Lumakanda SCH has 26 available beds versus a near-term requirement of 35 beds (74% of the target) and a long-term need of 57 beds (46% of the target). The Malava SCH shows the largest capacity gap, with 39 available beds compared with a near-term target of 57 beds (68% of the target) and a long-term target of 89 beds (44% of the target).

SDR activities also improved the service readiness of the Malava newborn unit by ensuring that it was equipped with incubators, resuscitators, suction machines, oxygen concentrators, and radiant warmers. One healthcare worker at Malava Hospital highlighted this transformation.

"The newborn unit was also supported, so we don't have to refer our preterm and low birth weight babies to CGH; we can manage them here."- Respondent 004

In addition to physical infrastructure improvements, SDR provides essential medical equipment, including delivery beds, BP machines, and Doppler monitors. Renovations in postnatal and labor wards have expanded patient capacity, with some facilities doubling their bed space (Figure. 3). The increase in delivery couches sought to reduce delays in labor interventions to allow timely maternal care.

The medicine and commodity data (*Additional file 2*) revealed that the three hubs maintained an availability rate above 70–80% for both medicines and commodities for ANC and child immunization and for essential MNH medicines[15] (Figure. 5).

The equipment and supplies data across the three facilities showed that the facilities maintained above 60% availability of the assessed list of essential equipment for basic and infection prevention equipment for general MNC services (*Additional file 3*), basic obstetric equipment (*Additional file 4*), and comprehensive obstetric equipment and supplies (*Additional file 5*), as shown in Figs. 6A, 6B, 6C, and 6D below.

Despite these improvements, some infrastructural advancements have been constrained. Upgrading Lumakanda Subcounty Hospital was difficult because of the limited space on the hospital grounds, and the hub benefited only from renovations and equipment supply to optimize existing spaces. In Malava, the dedicated maternity operating theatre remained nonoperational, despite being newly constructed as part of the SDR reform. The upgrading phase of Butere Sub-County Hospital was also delayed: county officials decided to build a new hospital instead of upgrading the maternity ward of the existing hospital. However, this ambitious project faced construction challenges caused by limited resource allocation. The existing hospital therefore only benefited from some new equipment, as it awaits the completion of the new building to house the maternity wing, and no formal guidance from the government for mothers to shift delivery locations took place in Butere.

Enhancing Emergency Transportation for Maternal and Newborn Care

The county government and the Rescue.co partnership improved emergency transportation for pregnant women and newborns. Previously, access to utility vehicles that were sometimes used for referral services was reportedly inconsistent due to fuel shortages, operational delays, and financial constraints. The introduction of a dedicated emergency transport system aimed to reduce these delays, ensuring timely referrals and life-saving interventions. Rescue's administrative data indicates that ambulance response times range from 10–30 minutes, likely reducing the risks associated with delayed treatment of labor complications and neonatal emergencies. Among the 14,842 rescue cases handled, 13,401 cases, approximately 90.3%, resulted in successful rescue and transport to health facilities as shown in Table 2. These data were collected during the implementation period, from the Rescue's initiation of services in November 2021 until the Rescue exited Kakamega in 2024. 2024.

Table 2
Emergency and Referral Data from Rescue.co[16], [17]

Status	**Count of mothers**
Advised and Discharged on Phone	749
Deceased Enroute to facility	2
Deceased on Arrival at facility	20
Deceased on Scene despite resuscitation attempts	42
Discharged. No intervention required	82
Found Deceased on Scene	22
Patient not found on Scene	135
Refused Evacuation	51
Refused Treatment (on scene)	1
Taken to a facility	13,401
Taken to a facility but then ferried to another	98
Towing	2
Treated on Scene	236
Grand Total	**14,841**

A common theme that emerged from in-depth interviews was positive impressions of the emergency transport system. For example, interviewees reported that home pick-up services improved community

confidence in the healthcare system. Mothers felt assisted and reassured that they could access emergency transport, increasing their willingness to seek care in the hubs.

“Clients are also feeling good… the motorbike was not available, but when I called the ambulance, it came, and I was ferried to the hospital. She feels good. She feels assisted.”- Respondent 010

The efficiency of the transport system was driven primarily by effective communication among health facilities, ambulance dispatch services, and communities. The integration of technology-enhanced coordination ensured that facilities were informed in advance of incoming patients and prepared for their arrival.

“A case comes in, so we are dispatching an ambulance, yes, but they already have started making calls and ensuring that we are sourcing or receiving a facility that has the right service.” – Respondent 022

The responsiveness of the rescue team was not only about the availability of ambulances but also the commitment and motivation of the personnel involved for them to maintain round-the-clock services.

“The most rewarding thing is that the project did not have limits. As long as a mother or a neonate is in an emergency, then they immediately qualify for an emergency service without any questions. You know, so that was truly rewarding because you're coming to aid someone who is in dire need.”- Respondent 022

The transport system also promoted health equity and accessibility by addressing financial and geographical barriers. The SDR offered free emergency transport, eliminating cost-related delays, ensuring that even the most vulnerable populations had timely emergency transport, and encouraging mothers to seek quality care.

“As long as a mother or a neonate was in an emergency, then they immediately qualify for an emergency service without any question... you're coming to aid someone who is in dire need.”- Respondent 022

“Home deliveries have reduced because since we told them they have the number they can call; you just see the ambulance dropping a mother in labor and so this issue of 'I did not have the funds' has truly reduced and so many clients are delivering at the facility as compared to before.”- Respondent 015

The in-depth interviews also indicate that while the transport system improved outcomes, challenges such as terrain accessibility and inconsistent ambulance availability remained.

“We’ve had a few cases where it was truly difficult for the ambulance to access this patient because of very, very exemplary bad terrain.”- Respondent 022

SDR implementation received a major blow in the transport system when the rescue team ended their transport services in 2024, as their funding elapsed, and the county could not sustain the transport system.

Human Resource Management and Development

SDR implementation activities included the integration of continuing medical education (CME) and emergency obstetric care (EMOC) training to improve the clinical competency of medical officers, nurses, and paramedics in handling obstetric emergencies with confidence. The training also included a mentorship program that addressed critical skill gaps, ensuring continuous learning.

The training was conducted in three phases: March 15–19, 2021; November 29–December 3, 2021; and March 6–11, 2023, with an additional cohort trained from 2024–2025 following a new cohort model and an updated curriculum. Figure 7A shows the distribution of mentors trained across different subcounties, with varying numbers of healthcare providers trained in each location.

Approximately 450 nurses, the largest cohort among healthcare providers, and a small number of medical officers, KRCHNs, clinical officers, and nutritionists were trained, as shown in Fig. 7B below. The projected infacility mentorship program (Fig. 7B) depicts the potential reach of the training through a cascading model. The projected numbers are based on a ratio of 1 IFM (In-facility Mentor) to 7 mentees per the JH estimation, showing how the initial training cohort was to expand to reach up to 500 plus healthcare providers through mentorship, with nurses representing the largest projected group for mentorship given their numbers and frontline role in maternal and infant care.

Health workers benefitted from the training described below.

“At least, it is a continuous thing that makes us learn every other day. Because we learn through CMEs, we learn through doing the drills. Therefore, when you get a real scenario, you can at least deal with it. Most of the nurses in maternity care confessed that surely, she was not, she was not managing the patients the way, she ought to because of gaps here and there... However, since she embraced the program, the mentorship program, it has built her. She's now competent, she can do; she can manage a PPH very well. She can even, there's many like breach deliveries. She can do breach because, you know, when you learn in school, you tend to forget some things.”- Respondent 009

In addition to the technical skills gained, health workers reported feeling supported, encouraged, and empowered in their roles, which led to renewed commitment and improved service delivery.

“You feel like there's somebody who is supporting you, at least there's positive support; you are encouraged to continue working, and you are hoping for the best.”- Respondent 010

The SDR facilitated the deployment of specialist doctors, including a resident pediatrician and an obstetrician-gynecologist at Malava Subcounty Hospital. However, our findings show that staff shortages still occur across all facility levels, resulting in high workloads, staff burnout, and compromised quality of care. The Malava specialist left their positions due to dissatisfaction with the job groupings, which they felt were below their expected jop group levels.

“We are very few, like now we are only two medical officers and the third one who is our in charge and you have to cover the facility for 24 hours that is day and night and now being a senior medical officer

everything ends with us and so all the referrals coming in, it's you and sometimes when you need to refer it is very difficult because we don't have consultants."- Respondent 011

SDR implementation aimed at aligning the healthcare workforce and ensuring that the right staff with the right skills were in the right place. Our findings showed that no significant staff transfers were made from level 2/3 to level 4 to improve service delivery. When transfers occurred, they were not perceived to be in the spirit of improving maternal and newborn services under the SDR; however, in some cases, they were perceived as punitive measures. These issues arose particularly when transfers did not align with healthcare workers' competencies and preferences, and the issue was further complicated when the transfers disregarded healthcare workers' specialized training and professional development investments.

"We have seen people who are truly working hard who are truly holding the departments and maybe they are there for the patient and they are moved out and the people who are being brought in, they are not... You know in medicine, you should be put in a department you are willing to and not any department."- Respondent 011

Technical support for financial management

To support SDR implementation, the Thinkwell team provided technical assistance to the county to ensure that investments in SDR remain sustainable through improving local revenue generation. The assistance enabled the county to develop and pass the Facility Improvement Fund (FIF) bill and guidelines, which enabled facilities to gain more autonomy over their finances by allowing Level 4 facilities to retain and manage their funds generated from service delivery. This health financing reform marked a shift from the previous centralized system where funds generated by facilities were remitted to the county's general revenue and managed at the county level. The implementation was supported, with seed money of approximately Ksh 57 million allocated to jumpstart the program.

As illustrated in Fig. 8, there are notable changes in revenue collection trends across the three subcounty hospitals (Butere, Malava, and Lumakanda), corresponding with the FIF policy launch in June 2023 and implementation beginning in July 2023. Malava Subcounty Hospital experienced a spike in revenue collection in July 2023, reaching approximately KES 20 million due to the significant disbursement from the NHIF of Ksh. 18 million accrued from June 2023. Financial autonomy allows facilities to better manage their resources and address specific needs, as one respondent explained.

"When you get back your money you buy as per your need and as per your budget and as per your consumption."- Respondent 018

This contrasted with the previous facility's revenue collection, management and use, where centralized purchasing often resulted in facilities receiving supplies that they did not need.

"When this money was coming at the county level, they normally used to buy things in the pool and then we were supplied with those things and then you find that at times you are brought things that you do not need

or maybe their consumption is very low at a certain facility and then they ended up expiring." Respondent 018

According to the ThinkWell Report shown in Fig. 9, despite the gains in financial autonomy, facilities continue to face challenges in revenue optimization. Malava Subcounty Hospital (SCH) surpassed its revenue target in quarter 1 due to the major disbursement covering arrears from the NHIF in July 2023; however, it experienced a drop in collection during quarter 2. Lumakanda and Butere SCH had increased revenue collection but could not reach their targets for quarters 1 and 2. One of the emerging issues was the delay in reimbursement to facilities for services provided, particularly by the NHIF for Linda Mama's claims.

In terms of supply chain financing, the ThinkWell Biannual Report July to Dec 2023 shows that substantial budget increases were implemented through a supplementary budget that added approximately Ksh 140 million to the Health Products and Technologies (HPT) allocation, bringing the total to Ksh 450.7 million. This included increased allocations for medical drugs (Ksh 230 M), nonpharmaceuticals (Ksh 122 M), laboratory materials (Ksh 90.7 M), and a new allocation for X-ray materials (Ksh 8 M). The supplementary budget demonstrated commitment to resource SDR implementation. However, despite these increased allocations, facilities continued to experience stockouts of essential medicines and supplies, suggesting that budget increases alone were insufficient without addressing procurement and distribution system weaknesses.

Technological Innovations

SDR implementation also included technological innovations such as SMS Prompts and a digital blood tracker system. Prompts are SMS-based communication systems developed by Jacaranda Health that aim to improve patient engagement and maternal healthcare communication by providing appointment reminders and health information. Mothers were enrolled during antenatal care, providing a direct communication channel between healthcare providers and mothers. As noted in one response:

"At least our pregnant mothers are reminded of when to visit, when is their due date for visit, and now it is truly helping to improve the ANC visits in the Subcounty."- Respondent 013

As a digital innovation to manage blood supply and distribution across health facilities, the blood tracking system was designed as a digital platform to monitor blood stock levels and improve visibility. The system was intended to facilitate better coordination between facilities and emergency services. However, the implementation faced challenges due to its partially manual nature, requiring frequent follow-ups:

"We are no longer using it because we realized it was a digital tool, yes, but it was a bit manual because you have to take 2–3 days they have not filled the tool so you have to call and remind."- Respondent 019

As a result, the system was replaced with a simpler Excel-based tracking method, which had limited reach across the health facility networks in the county.

“We just did an Excel sheet whereby we ask the facility, have you received blood for this month? How much do you have in stock? How much have you spent? And then out of what you have spent, how many went for MNH cases?”- Respondent 019

Unexpected outcomes

The implementation of service delivery redesign (SDR) in the Kenyan healthcare system revealed several unexpected outcomes, demonstrating the complexity of health system interventions. While the redesign aimed to improve maternal healthcare delivery, it triggered various unintended consequences across different aspects of the health system. These consequences can be organized into four interrelated categories: demand-side effects, health worker responses, system and organizational effects, and cultural and community perceptions.

Demand-Side Effects: Patient Behavioral Adaptations

Patients adapted their healthcare-seeking behaviors in response to SDR implementation, sometimes in ways that undermined the intervention’s intended pathways. Some patients manipulate the system by exaggerating symptoms to secure ambulance services, recognizing the benefits of free emergency transport. Others deliberately delay care seeking until late in labor rather than seeking earlier care antenatal care at lower-level facilities.

These behavioral adaptations reflected patients’ perceptions that quality care was only available at Level 4 facilities, leading them to bypass or delay lower-level services. Additionally, patient volume at higher-level facilities increased without corresponding resource increases, as women actively sought care at the designated hubs rather than utilizing the hierarchical referral system as intended.

Health Worker Responses and Professional Effects

Health workers at various levels responded to SDR in ways that created operational challenges. Some lower-level facility staff misinterpreted the policy and began automatic referrals without proper assessment. Staff transfers from hubs to peripheral facilities also increased the fear of skill deterioration since they were not going to conduct deliveries at lower-level facilities. This concern about deskilling created resistance to transfers and affected staff morale. At higher-level facilities, increased patient volume without corresponding resource increases led to shortened postdelivery observation periods, compromising care quality, as they struggled to manage the workload with existing resources.

System and Organizational Effects: Administrative and Financial Disruptions

At the organizational level, SDR triggered several system-wide disruptions. Power struggles developed around financial control, with senior management interference affecting system stability and staff morale, particularly with respect to revenue allocation from the Facility Improvement Fund. Lower-level facilities feared losing Linda Mama reimbursements as deliveries shifted to hubs, creating anxiety about financial sustainability and potential facility closures. The emergency ambulance service, while

successful during implementation, became unsustainable when external support ended, revealing inadequate planning for long-term financing. Resource strain intensified at Level 4 facilities, which faced increased patient volumes without proportionate increases in staffing, supplies, or infrastructure capacity beyond the initial renovations.

Cultural and Community Perceptions: Trust and Traditional Roles

Cultural challenges have emerged around various aspects of SDR implementation. Some communities associate ambulances with severe illness or death. The diminishing role of Traditional Birth Attendants created tensions in the referral chain. Patient perceptions shifted to associating quality care only with level 4 facilities, undermining trust in lower-level facilities and their capacity to provide appropriate antenatal and postnatal care. This erosion of trust in the hierarchical system created a self-reinforcing cycle where lower-level facilities became further marginalized.

Interconnected Consequences: A Complex Adaptive System Response

As illustrated in Fig. 10, the causal loop diagram reveals how the Kakamega SDR may have triggered complex, interconnected consequences throughout the healthcare ecosystem on the basis of themes that emerged from in-depth interviews. At the center, the interview findings suggest that the SDR could have directly impacted multiple system elements, potentially creating both reinforcing loops (shown in red) and cross-system relationships (shown in blue).

Key reinforcing cycles may connect cultural and trust dynamics with health system hierarchy effects, creating feedback loops where diminishing trust in lower-level facilities could perpetuate hierarchical disparities within the system. Another significant reinforcing pattern that emerged from interviews might link cultural and trust dynamics directly to patient behavioral adaptation, illustrating how shifting trust perceptions may have prompted patients to adapt their healthcare-seeking behaviors in ways that further disrupted intended referral patterns.

The cross-system relationships (represented by blue arrows) demonstrate connections between seemingly separate health system blocks: health system hierarchy effects may influence administrative and power dynamics, which in turn could affect financial flow disruptions, creating possible unexpected linkages across organizational and financial dimensions. Similarly, the interview themes suggest how health system hierarchy effects might influence financial flow disruptions, creating possible cross-functional relationships between structural, governance, and financial aspects of the health system.

These cross-functional relationships that emerged from participant accounts suggest how SDR impacts could have transcended traditional healthcare system boundaries, with changes in one area potentially precipitating cascading effects in seemingly unrelated components of the health sector. The diagram

identifies critical nodes that participants reported, including ambulance service misuse, automatic referrals, fear of skill deterioration, and resource strain and quality.

Discussion

The service delivery redesign (SDR) implementation in Kakamega County demonstrated some achievements alongside notable challenges and unexpected consequences. Political support proved crucial, with executive endorsement enabling successful policy development, including the Facility Improvement Fund (FIF), which granted Level 4 facilities financial autonomy. The infrastructure improvements included the successful construction and renovation of maternity wings at Malava and Lumakanda hospitals, increasing the bed capacity from 10–26 beds at Lumakanda and 22–39 beds at Malava, although substantial gaps remain against the projected targets (ranging from 44–68% of long-term capacity needs). The emergency transport system achieved a 90.3% success rate (13,401 of 14,842 cases) with response times of 10–30 minutes, significantly improving access to care, but faced sustainability challenges when external funding ended in 2024. Human resource development through emergency obstetric care training has enhanced clinical competency, although staff shortages and the inadequate retention of specialists continue to compromise service quality. Technological innovations such as SMS prompt improved communication, but the use of a digital blood tracker was discontinued because of manual requirements. Most significantly, the implementation revealed complex unintended consequences, including ambulance service misuse, automatic referrals without proper assessment, cultural resistance to ambulance use, diminishing trust in lower-level facilities, and power struggles over financial control, creating reinforcing feedback loops that potentially undermined the intervention's intended hierarchical care model and highlighted the intricate interconnectedness of health system components.

Sustainability challenges

Despite initial political commitment and successful policy development, sustaining SDR reforms faced profound challenges that threatened long-term viability. The most evident sustainability issue emerged when the emergency transport system, which achieved a 90.3% success rate during implementation, became unsustainable following the withdrawal of the partner supporting it. Notably, the transport system's implementation deviated from the original SDR model, which envisioned 24/7 interfacility transport and nighttime support for remote mothers, expanding instead into a comprehensive emergency response service without adequate planning for sustainable financing and government absorption. While the FIF policy represented progress toward financial autonomy, financial management issues persisted, with delayed fund disbursements and concerns about proper resource allocation. Level 4 facilities frequently struggle to generate sufficient revenue to procure supplies, maintain equipment, and retain a contracted health workforce, revealing limitations in the self-financing model. The shift from politically driven, ad hoc decisions to institutionalized, policy-backed management represented progress, particularly in handling emergency services where new policies helped "seal loopholes" that previously allowed political interference. However, sustaining political will remained fragile, with one informant

cautioning: "In terms of financing, yes we have the policies, we have the finances in place, but this cannot miss political interferences" (Respondent 019). Changes in leadership, competing priorities, and the natural political cycle threatened the continuity of the reforms. These sustainability challenges collectively undermined the institutionalization of SDR components and exposed the vulnerability of health system reforms, which both deviate from original sustainable designs and rely heavily on external funding without robust transition planning and government financing mechanisms.

Theoretical Contribution and Complex Adaptive Systems

The study's unique contribution lies in its documentation of both intended achievements and complex unintended consequences, revealing how service delivery redesign interventions can generate cascading effects across seemingly unrelated health system components. The observed unintended consequences align with the emerging literature on complex adaptive systems in healthcare, which emphasizes that understanding the CAS phenomena of path dependence, emergent behaviour, scale-free networks, feedback loops and phase transitions is important for better planning, implementation, monitoring and evaluation approaches to scale up health services [20], [21]. This comprehensive analysis addresses a critical gap in the literature, where lessons from CAS suggest paying more attention to the local context, incentives and institutions; anticipating unintended consequences; and developing programmes that engage key actors through the transparent use of data for ongoing problem solving and adaptation [22], [23].

This study makes significant theoretical contributions to the implementation science and health system strengthening literature through its innovative application of the RE-AIM framework for the process evaluation of complex health system interventions. While the RE-AIM framework's five domains—reach, effectiveness, adoption, implementation and maintenance—have been successfully applied to evaluate maternal and child health interventions, including the EMBRACE intervention in Ghana and the Maternal and Child Health Handbook program in Angola [24], [25], this study focuses specifically on implementation fidelity, stakeholder acceptance (an adapted interpretation), and maintenance (sustainability aspects observed during implementation), with limited assessment of effectiveness or population-level reach given the process evaluation design and timing during the implementation phase. The study extends traditional RE-AIM applications by adapting the framework to fit health system redesign contexts and augmenting it with complex adaptive systems to capture the implementation processes, stakeholder responses, sustainability challenges, and unintended consequences that emerged from the intervention. The theoretical advancement lies in bridging implementation science theories with complex adaptive systems thinking, addressing calls for a better understanding of how and why implementation succeeds or fails [26], [27]. This study contributes to the growing recognition that complexity theory represents a promising direction for implementation science by considering health care organisations as complex adaptive systems [28]. Methodologically, this work advances process evaluation approaches by systematically documenting unintended consequences, revealing how cultural resistance and system interconnectedness can create unexpected pathways that fundamentally alter intervention effects [29]. This approach fills a critical gap in evaluation methodologies that typically

focus on outcome measurement rather than understanding the complex mechanisms through which interventions generate both positive and negative effects [30], [31]. The study's balanced analysis of success and failure provides a more nuanced understanding of implementation fidelity and sustainability challenges in low-resource settings [32], [33].

Policy and Practice Implications

The findings from this study have profound implications for health system strengthening policies and practices, particularly in low- and middle-income countries. For policymakers, the results underscore the critical importance of anticipating and planning for unintended consequences when implementing service delivery redesign interventions [34]. The study reveals that successful infrastructure improvements and emergency transport systems can be undermined by inadequate attention to sustainability mechanisms, cultural acceptance, and system-wide coordination. The finding that ambulance services became unsustainable when external funding ended highlights the need for robust financing mechanisms that ensure the long-term viability of emergency transport systems [35], [36]. For practitioners, the results emphasize the importance of comprehensive stakeholder engagement and cultural sensitivity in intervention design and implementation [37]. The study's documentation of both successful elements and implementation challenges provides practical guidance for future service delivery redesign initiatives, emphasizing the need for adaptive management approaches that can respond to emerging challenges while maintaining intervention fidelity [20], [38].

Overall, our evaluation reveals that while SDR introduced important improvements in maternal healthcare infrastructure, equipment availability, emergency transport, and financial autonomy, significant gaps remained in policy implementation, human resource management, and service centralization. The initiative's sustainability was compromised by its dependence on partner funding for critical components and deviation from the initial model, as in the case of the emergency transport system. These findings underscore the need for comprehensive health system strengthening that addresses all interconnected elements simultaneously and with adequate resources to achieve sustainable improvements in maternal and newborn healthcare. The Kakamega SDR implementation study also opens several critical avenues for future research in health system strengthening and implementation science. First, research should investigate sustainable financing mechanisms for emergency transport systems and other critical components of maternal health services in low-resource settings. Second, comparative studies across different contexts are essential for understanding how local factors influence the success and failure of similar interventions. Finally, research is needed to assess the efficiency of the healthcare system after the implementation of the SDR.

This study has several limitations. Some quantitative data were obtained from implementing partners, which may introduce reporting bias. Additionally, because data collection occurred while external partners were still actively supporting the programme, the study provides limited insight into long-term sustainability following the withdrawal of external funding. Despite these limitations, the mixed-methods

design and data triangulation strengthen the reliability of the insights generated regarding the complexities of implementing large-scale health system redesign in resource-limited settings.

Conclusion

SDR implementation in Kakamega County demonstrates the potential and challenges of health system-strengthening initiatives in low-resource settings. While improvements were achieved in infrastructure, emergency referral services, and capacity building, important lessons emerged regarding unintended consequences and sustainability considerations. These findings contribute to the growing body of evidence on implementing maternal health interventions in resource-limited settings and offer valuable insights for similar future initiatives.

Abbreviations

ANC
Antenatal Care
BEmONC
Basic Emergency Obstetric and Newborn Care
CEmONC
Comprehensive Emergency Obstetric and Newborn Care
CEC
County Executive Committee
CHMT
County Health Management Team
CHV
Community health volunteer
COG
Council of Governors
EmONC
Emergency obstetric and neonatal care
FGD
Focus Group Discussion
FIF
Facility Improvement Fund
HPT
Health products and technologies
KII
Key informant interview
LMIC
Low- and middle-income country
MCH

Maternal and Child Health
MNH
Maternal and Newborn Health
MOU
Memorandum of Understanding
NBU
Newborn Unit
NGO
Non-Governmental Organization
PNC
postnatal care
RE-AIM
Reach, Effectiveness, Adoption, Implementation, Maintenance
SCH
Subcounty Hospital
SDR
Service delivery redesign
SMS
Short Message Service
TBA
traditional birth attractant
TWG
Technical Working Group
UHC
Universal Health Coverage
WHO
World Health Organization

Declarations

Ethics Declaration

This study adhered to the Declaration of Helsinki and received scientific and ethical approval from the Kenya Medical Research Institute Scientific and Ethics Review Unit (KEMRI/SERU/CGMR-C/4226). All the participants were provided information sheets, and the participants provided informed, written consent prior to any data collection.

Patient and Public Involvement Statement

Community members, including women with recent deliveries, men/birth companions, traditional birth attractants, and community health volunteers, participated in focus group discussions, contributing their perspectives on SDR implementation. Community stakeholders were engaged throughout SDR implementation through quarterly dialogue sessions and maternity open days. The study findings will be disseminated to community stakeholders through County Health Management Team meetings and community forums organized by implementing partners.

Consent for publication

NOT APPLICABLE

Competing interest

The authors declare no competing interests.

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Author Contribution

J.N conceptualized the study, E.O and H.K conducted the interviews, B.A and J.N undertook the analysis, and B.A developed the first draft of the manuscript. K.C, J.C, K.O, and M.K contributed to the subsequent drafts, and all the authors approved this version of the manuscript for publication.

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Data Availability

The quantitative datasets (facility surveys, provider assessments, and emergency transport data) supporting the conclusions of this article are available from the corresponding author upon reasonable request and are subject to institutional data sharing agreements with the Kemri-Wellcome Trust Programme and implementing partners (Jacaranda Health, Rescue.co). Qualitative interview transcripts are not publicly available to protect participant confidentiality, but anonymized quotes are provided in the manuscript.

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Figures

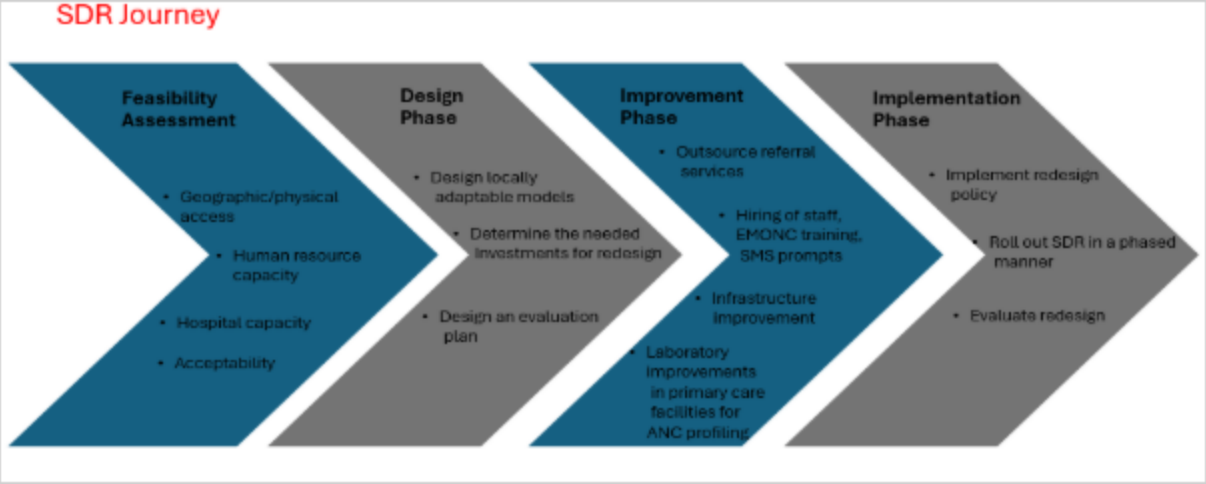


Figure 1

Phases of SDR implementation in Kakamega

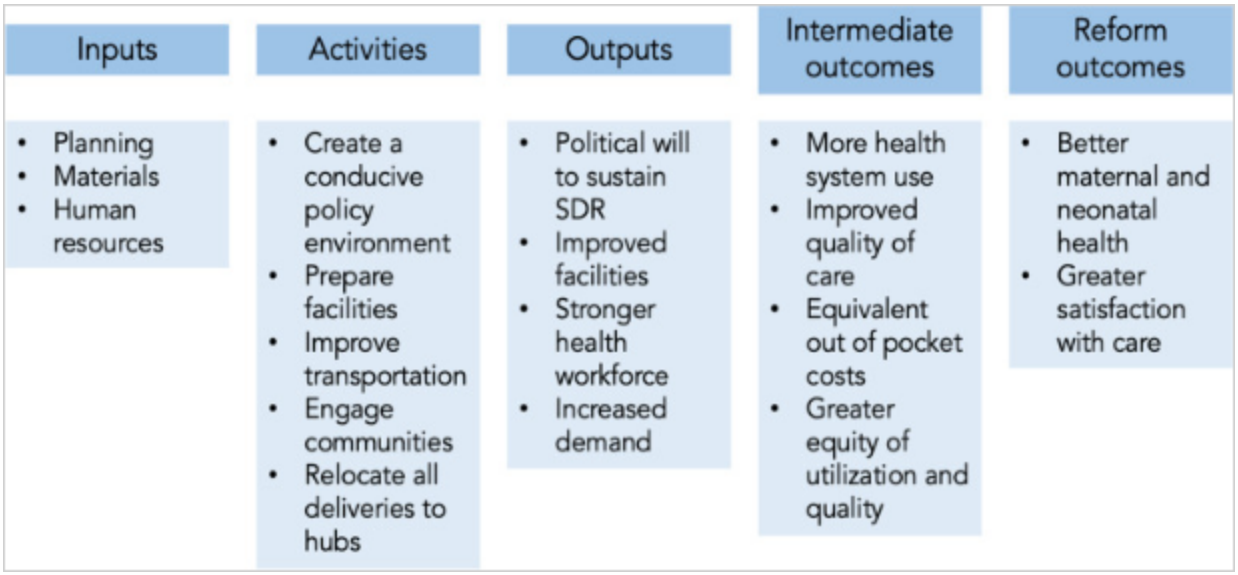


Figure 2

Service Delivery Redesign Theory of Change[5]

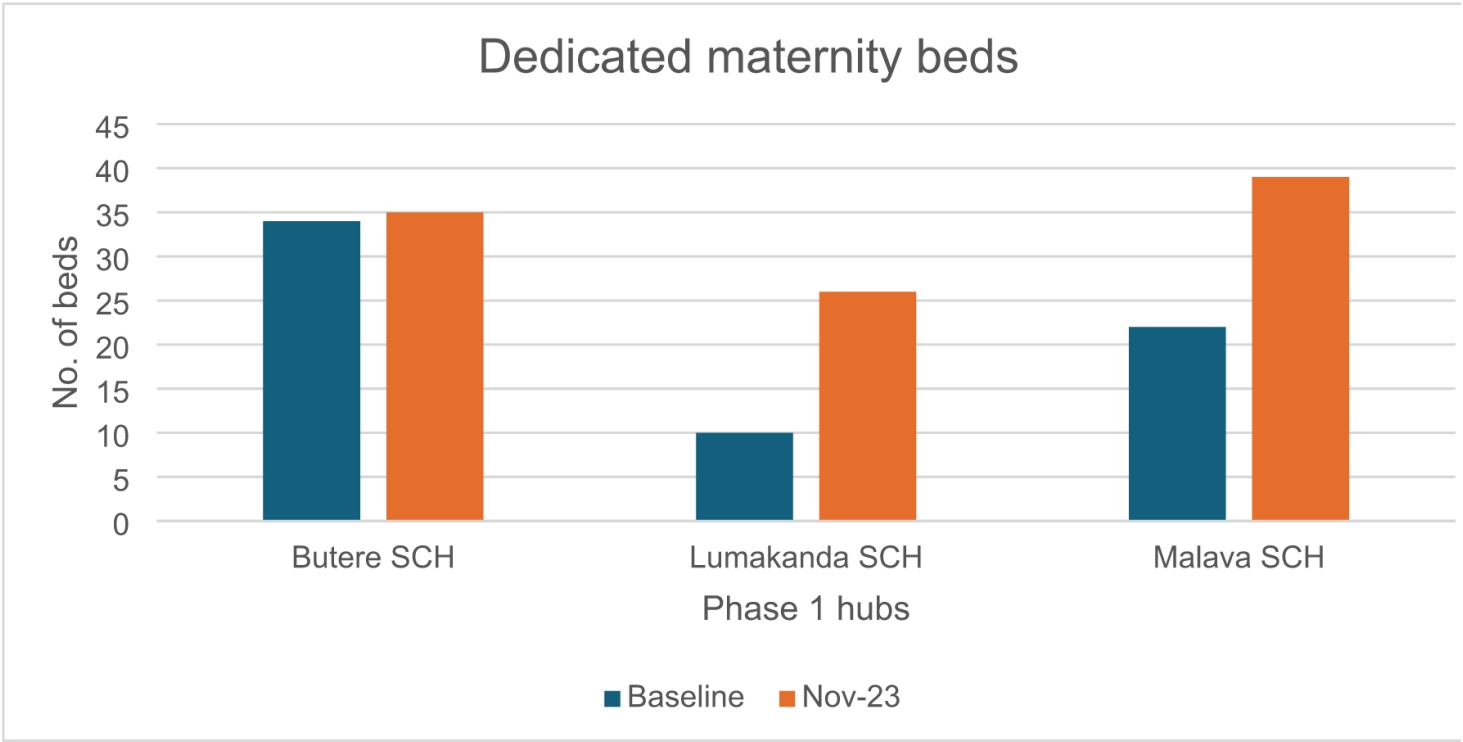


Figure 3

Dedicated maternity beds

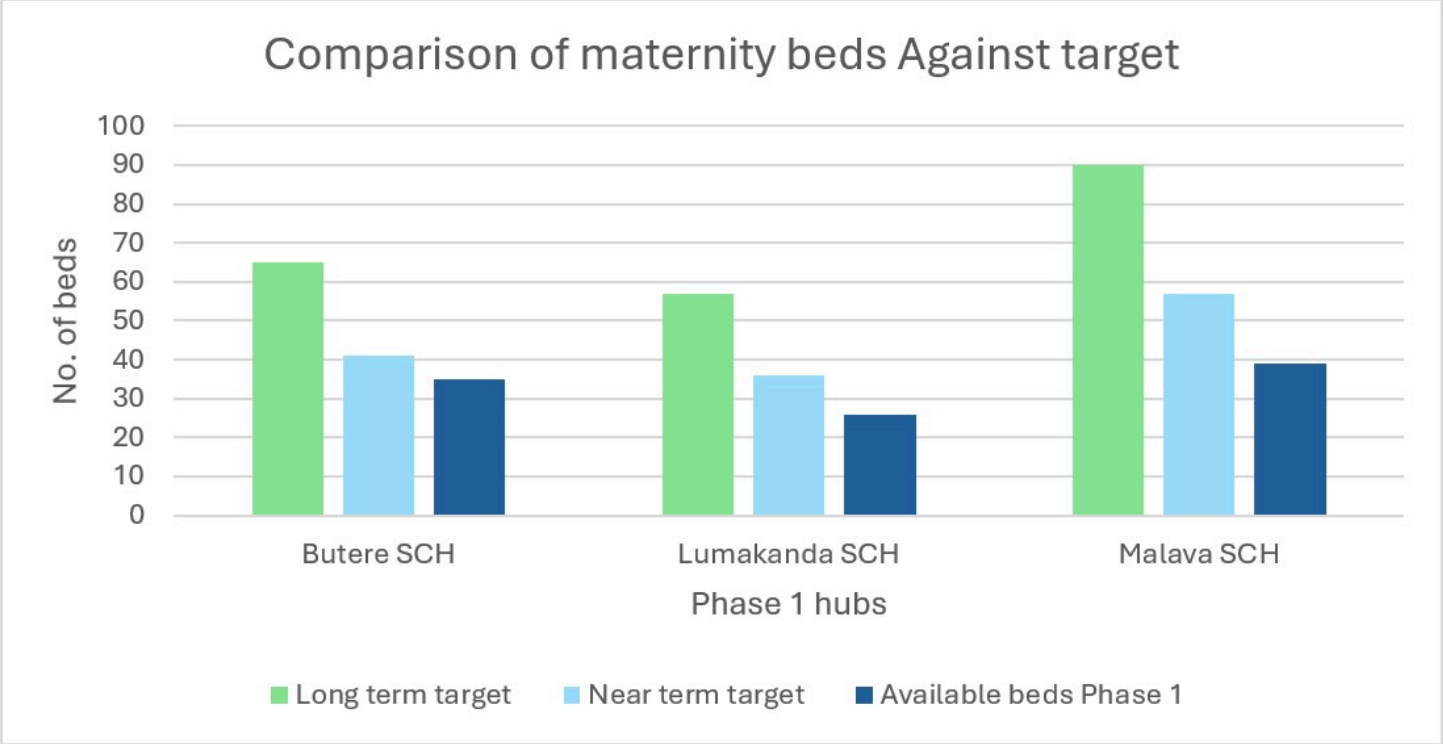


Figure 4

Comparison of maternal beds against the target

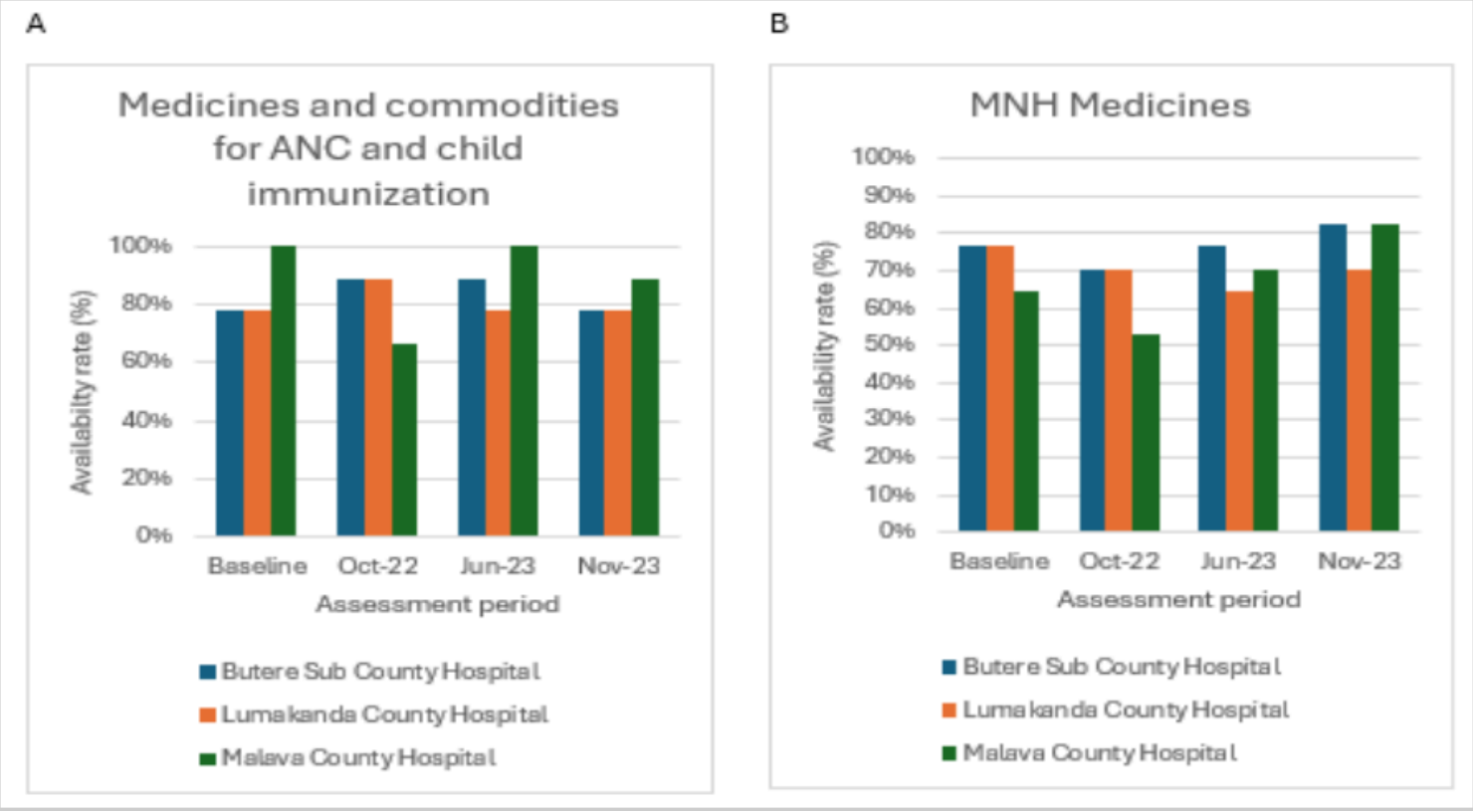


Figure 5

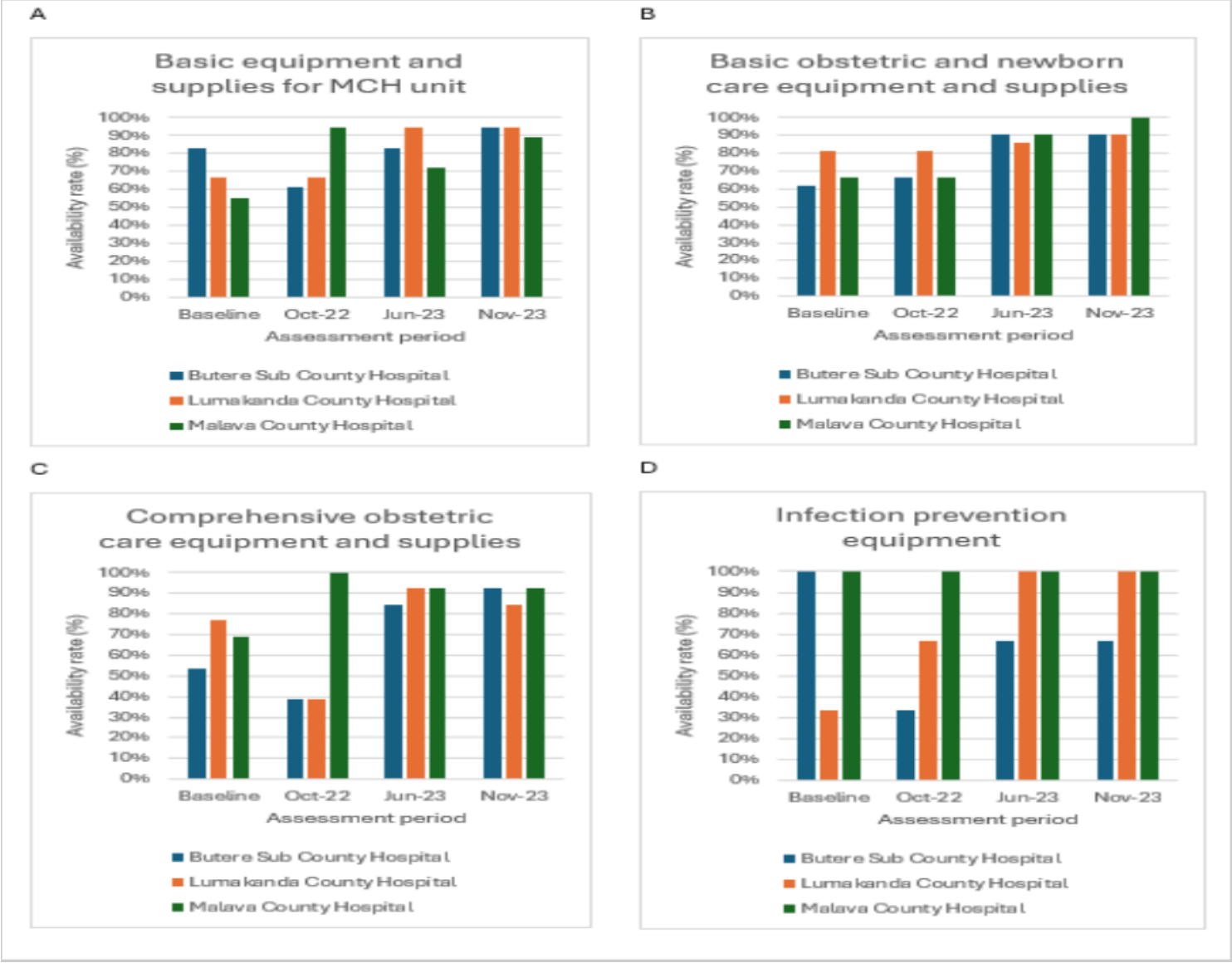


Figure 6

Equipment and Supplies

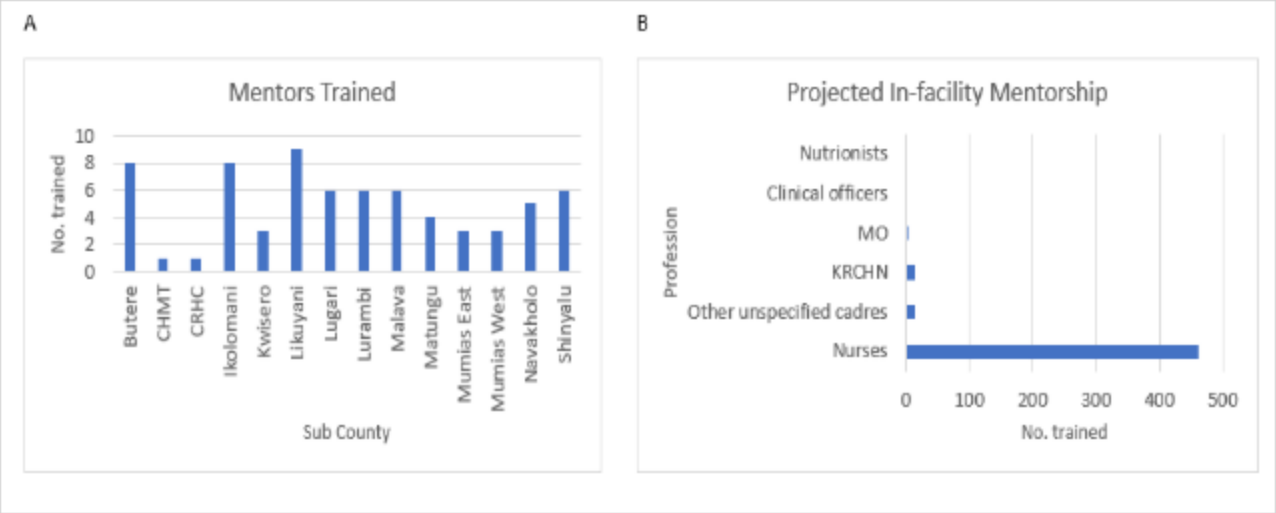


Figure 7

Health provider trained data from Jacaranda Health [18]

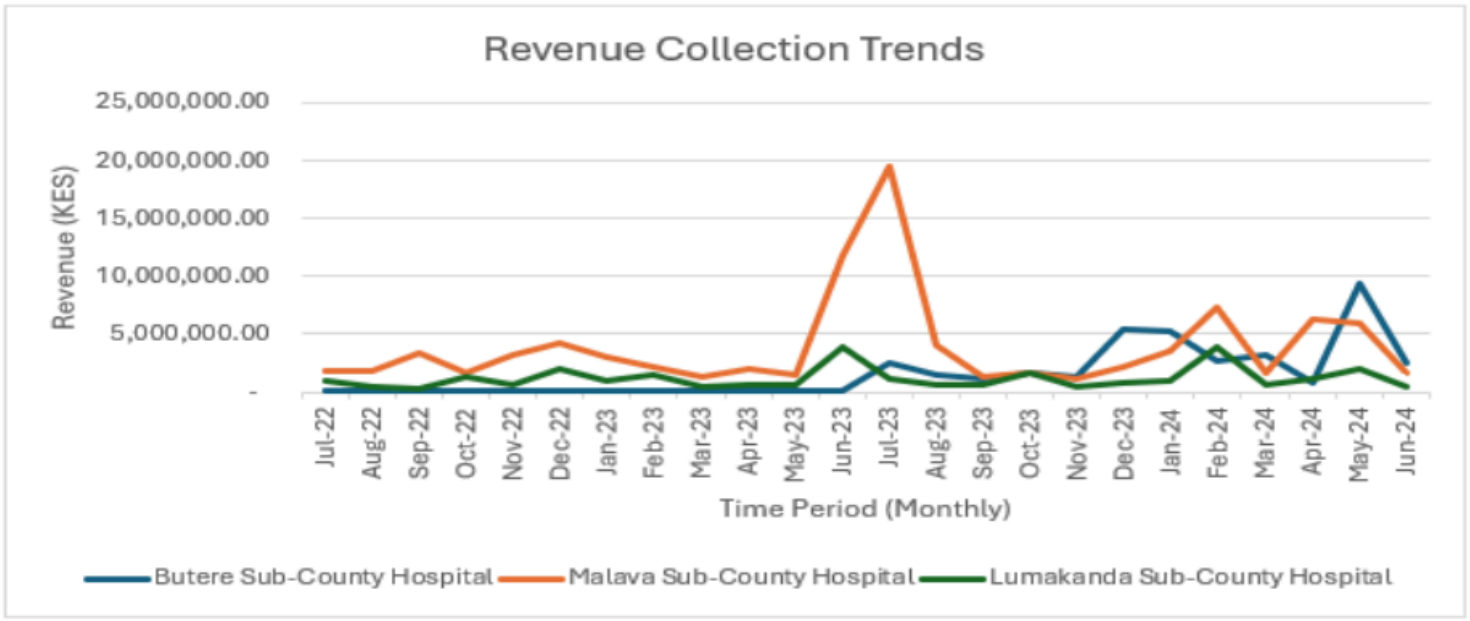


Figure 8

Revenue collection trends

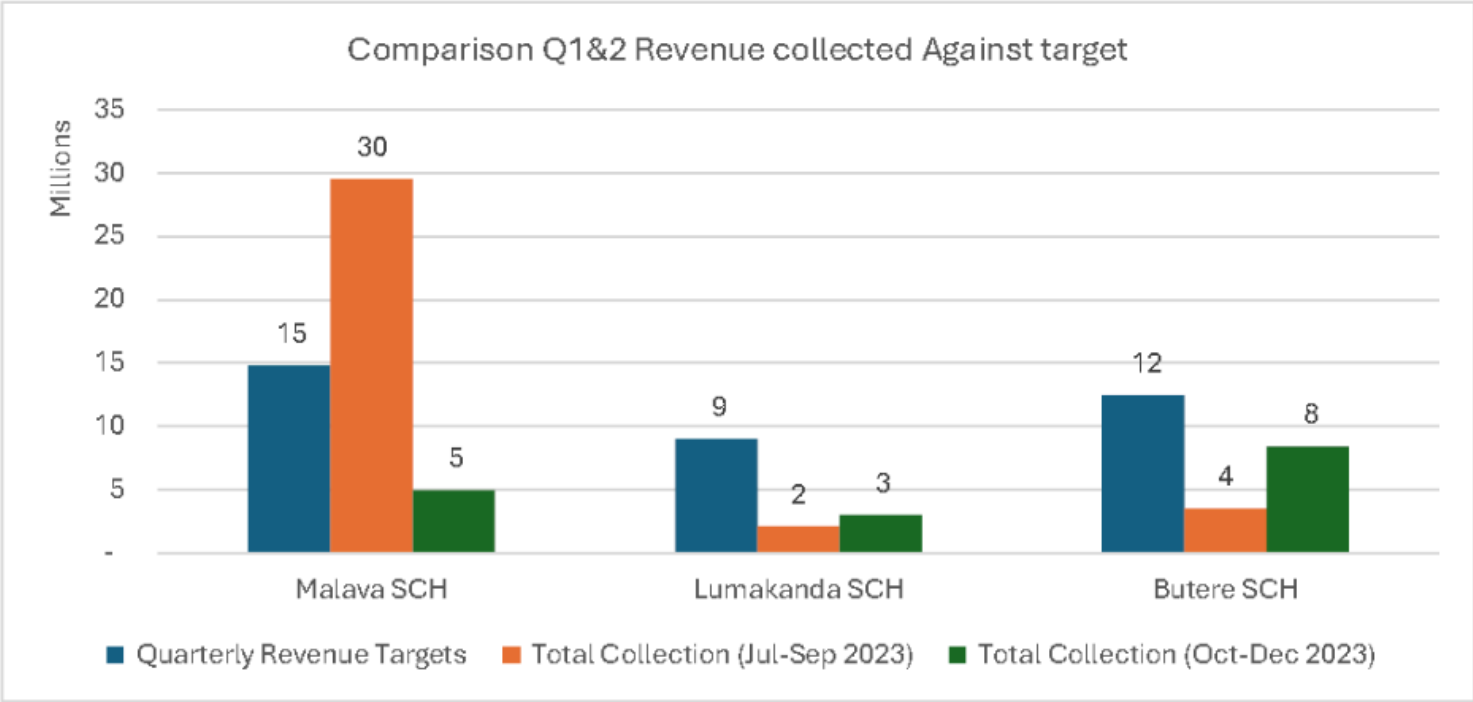


Figure 9

Revenue collected against the target (Source: ThinkWell Biannual Report July to Dec 2023 [19])

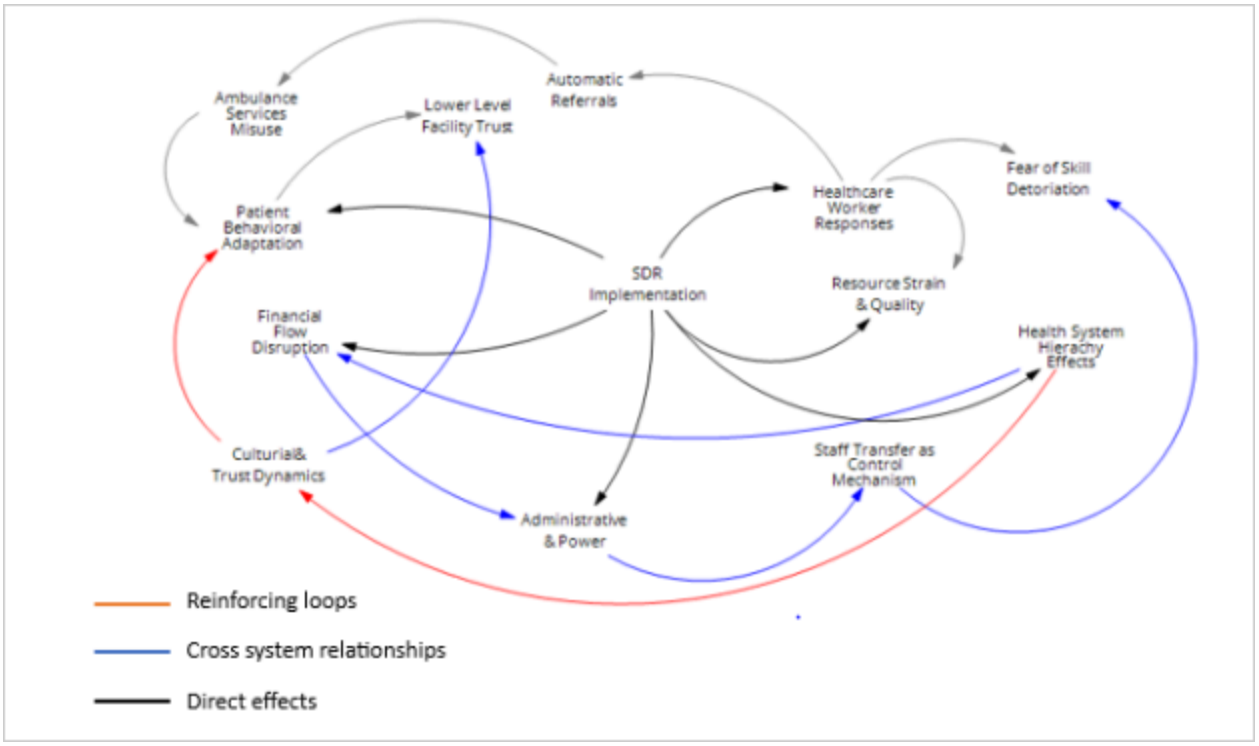


Figure 10

Causal loop diagram of unexpected outcomes

Supplementary Files

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