

Mixed-Methods Evaluation of a Multi-level, Multi-Component Implementation Theory: Results from Scaling Up Obstetric Triage in Six Referral Hospitals in Ghana

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Abstract

Introduction Ghana has achieved steady reductions in maternal and newborn mortality; however, delays in receiving appropriate care after hospital arrival continue to contribute to preventable deaths. Timely clinical assessment is particularly critical for women with high-risk or complicated pregnancies. In response, Kybele, Inc., in partnership with the Ghana Health Service, developed a midwife-led obstetric triage system to improve rapid assessment and prioritization at hospital arrival. Following successful pilot implementation, the Obstetric Triage Implementation Package (OTIP) was scaled to additional hospitals using a rigorous, theory-based implementation science approach. This study evaluates the clinical and implementation outcomes of OTIP and examines how a multilevel theory of change contributed to achievement of results.

Methods A Type II hybrid implementation–effectiveness pre–post study design was employed for an intervention conducted in six public hospitals in Ghana between 2019 and 2022. The primary clinical outcome was the proportion of women assessed within 10 minutes of arrival. Implementation outcomes included adoption (percentage of women receiving color-coded wristbands), fidelity (accuracy of risk categorization), and sustainability (extent of normalization). Quantitative data were collected at baseline and at three post-implementation timepoints using direct observation and random triage record sampling. A convergent mixed-methods approach using Contribution Analysis assessed implementation processes through readiness assessments, staff surveys, leadership interviews, learning network documentation, and Technical Advisory Group (TAG) interviews.

Results At baseline, 5% of women were assessed within 10 minutes of arrival; this increased to 85% at 12 months post-implementation. Adoption was high and sustained, with 96% of women receiving wristbands across sites and timepoints. Fidelity was maintained, with 83% accurate risk classification. Sustainability assessments demonstrated strong integration of triage into routine care, with high scores for coherence and collective action across facilities. Qualitative findings identified facility-based champions, iterative problem solving, leadership engagement, cross-facility learning networks, and TAG support as mechanisms enabling adoption, fidelity, and sustainment despite persistent system-level constraints.

Conclusion OTIP achieved sustained improvements in timely obstetric assessment and implementation outcomes across diverse settings. A theory-driven, multilevel implementation approach was central to success, offering actionable insights for scaling complex health interventions in low-resource settings.

Trial registration: Not applicable

Background

Ghana has made significant strides in reducing maternal and newborn mortality, decreasing maternal deaths from 634 per 100,000 live births in 1990 to 223 in 2023, and newborn deaths from 42 per 1,000 live births to 21.¹ This progress, which includes increasing facility births with skilled attendants and referring high-risk cases to higher-level hospitals, aligns with global trends observed during the Millennium Development Goals (MDGs) period.² Despite these advances, substantial challenges remain, particularly concerning the quality and timeliness of care provided within tertiary healthcare facilities. Addressing the "third delay"—the delay in receiving appropriate treatment upon arrival at a healthcare facility, especially for high-risk mothers and newborns—remains critical to improving maternal and newborn outcomes in Ghana.³

The third delay begins when a pregnant woman arrives at a health facility, with delay in initial assessment being a key component. Delays in assessment can have serious repercussions for women experiencing high-risk or complicated pregnancies, as well as for their newborns.⁴ To address this need, the Ghana Health Service (GHS) and Kybele, a US-based non-governmental organization, developed an innovative obstetric triage system starting in 2013. This system was designed to help midwives assess, diagnose, and determine appropriate care plans more quickly and accurately.⁵ The obstetric triage system was initially developed and tested at Greater Accra Regional Hospital (GARH) and later introduced at Tema General Hospital. The success of these implementations led to the launch of the Obstetric Triage Implementation Package (OTIP) in

2019, aiming to scale the triage system to six additional hospitals in Ghana.⁶ This project used a rigorous implementation science approach, based on a theory of change to develop multi-level implementation strategies.

The objective of this paper is to present the results of an evaluation of the OTIP implementation. A protocol for the evaluation, describing the theory of change, the details of the OTIP intervention, and the implementation strategies was previously published.⁶ This manuscript explores the extent to which a systematic, theory-based implementation approach can accelerate and sustain the achievement of implementation and clinical outcomes and demonstrate how implementation theory can be used to operationalize and scale complex health interventions in real-world settings.

OTIP Overview

Intervention

The obstetric triage system is a midwife-led intervention focused on rapid clinical assessment and prioritization. Upon hospital arrival, patients are directed to a designated triage area where midwives evaluate their medical history, vital signs, and labor progression using a standardized assessment form. Based on the assessment, women are classified into risk categories: high (red), intermediate (yellow), or low (green) risk, and are given color-coded wristbands accordingly. A care plan is formulated based on the woman's diagnosis and risk level. This triage system is designed to enable quick and precise assessment and care planning as an integral part of midwifery practice, however, physicians are trained and sensitized as well.⁷

Implementation Approach

The theory of change, shown in Fig. 1, is based on a package of implementation strategies encompassing a multilevel (within facility, across facility and overall health system) capacity building approach.⁶ At the facility level, implementation was led by triage champions—midwives and physicians trained as facilitators, change agents, and implementation coaches. The champions monitored the adoption and fidelity of the intervention implementation and developed and tested approaches to solving implementation related problems using the Model for Improvement quality improvement method as a guide.⁸ At the cross-facility level, a learning network, facilitated through a WhatsApp platform, allowed triage champions to share insights, ask for guidance, and collectively problem-solve. This network supported in-person learning sessions where champions shared successful practices and discussed adaptations to enhance implementation outcomes. At the national health system level, a Technical Advisory Group (TAG) comprising leaders from the GHS and national triage champions provided oversight and support for the implementation process. This included two National Champions (one physician and one midwife) and six other TAG members holding current and former positions within the GHS and its Institutional Care Division and the Family Health Division. The TAG met quarterly to discuss implementation challenges, to address policy barriers, and to advocate for integrating obstetric triage into national practice (Fig. 1) ⁹.

OTIP Outcomes

The OTIP evaluation focused on both clinical and implementation outcomes. The goal of triage is to assess and prioritize mothers as soon after arrival as possible. The percent of women assessed within 10 min was the **clinical outcome** of interest along with three **implementation outcomes**: *adoption*, measured by the percentage of women who received colored wristbands after assessment; *fidelity*, measured by the percentage of women who were banded accurately (indicating that the triage process was correctly followed); and *sustainment*, measured by the extent to which the intervention was locally embedded. These outcomes were measured using a combination of patient records, direct observations, and staff surveys.⁶

Methods

Setting

The six hospitals selected for OTIP are public hospitals in Ghana that conduct 4,000 to 7,000 births per year. These are Nsawam Government Hospital (Nsawam), Ga South Municipal Hospital (Weija), Eastern Regional Hospital (Koforidua), Ga West Municipal Hospital (Amasaman), Bono Regional (Sunyani) and Sunyani Municipal Hospital (Sunyani) located across three administrative regions of the country. Implementation took place from 2019 to 2022, with delays incurred because of COVID-19.

Evaluation Questions

The goal of the evaluation was to study the outcomes of OTIP and the implementation process.

The evaluation question related to the *outcomes* is:

1. To what extent did the obstetric triage program achieve its clinical and implementation outcomes and how were these outcomes sustained following implementation?

The evaluation questions related to the implementation *process* were reported in the evaluation protocol and reproduced below:

2. To what extent were components of the implementation theory used in guiding the implementation process?
3. How effective was this theory in accelerating and sustaining the implementation of obstetric triage? What were the mechanisms by which this occurred?
4. To what extent did the theory result in changes beyond the level of individual facilities (e.g., changing norms or policy across multiple facilities)?
5. What insights garnered from this specific implementation theory can be generalized to other settings, helping to define a mid-range theory about the implementation of evidence-based interventions in new settings?

Evaluation Design

As described in the evaluation protocol,⁶ the evaluation design for OTIP outcomes was a Type II hybrid implementation-effectiveness pre-post design.¹⁰ Outcome data were collected at baseline and at three timepoints post-implementation. A convergent mixed-methods approach was used to study the implementation process.¹¹

Evaluation Data

Quantitative and qualitative data were collected over the course of implementation as detailed below.

Data to Assess Outcomes

Clinical Outcome: At baseline, the patient waiting time from obstetric ward arrival until initial assessment by a healthcare provider was recorded by a trained observer. Following the intervention, arrival to assessment times were collected through the random sampling of triage assessment forms collected at three key intervals across participating facilities: 3–4 months, 5–7 months, and 12–14 months. The goal was to sample waiting time for at least 75 women per hospital at each interval; however, in two hospitals, the baseline target was adjusted to 50 observations due to COVID-19 pandemic limitations. Even with these restrictions, the baseline sample size was determined to be sufficient, providing 95% confidence and 80% power to detect an increase in timely assessments, consistent with the previous findings at GARH from 22% to 65%.⁵

Adoption and Fidelity: These were evaluated using two primary indicators: the percentage of women given a wristband, and the percentage of women whose risk classification was accurate (i.e., women were given the correct color of wristband based on the clinical findings at triage). These indicators were derived from the randomly sampled triage assessment forms, as described above. Fidelity was determined by a British obstetrician (FB) who reviewed the clinical details documented in each triage assessment form against the wristband color administered to determine accuracy in the assignment of risk acuity. The

3-4- and 5-7-month data sampling periods were considered the *monitoring phase* of implementation, whereby champions reported wrist banding compliance, wrist banding accuracy, and the degree of chart completion. After the second (5–7 month) data sampling period, monitoring was discontinued and there was minimal interface between the institutions and the TAG, the national trainers and the monitoring team. The third data sampling period (12–14 months), therefore, represents the *sustainability phase*, whereby institutions had approximately 6 months to independently maintain the intervention.

Sustainment: The Normalization Process Theory (NPT) questionnaire was used and participants in the assessments use a 5-point Likert scale to indicate their level of agreement or disagreement with statements provided in the questionnaire assessment.¹² These scores were averaged across facilities to provide a comprehensive understanding of the implementation process. Data from the assessments were analyzed and scores were categorized into the four NPT constructs: coherence, cognitive participation, collective action, and reflexive monitoring to understand the facilitators and barriers to OTIP implementation. This analysis provided insights into how the intervention was embedded and integrated into the healthcare facilities, highlighting the practical aspects of the implementation process.

Data to Assess Implementation Process

Facility Readiness: Readiness assessments were conducted to evaluate the preparedness of healthcare facilities to implement the OTIP. These assessments utilized a modified version of the R = MC² readiness heuristic^{13,14} measuring readiness across three dimensions: motivation, general capacity, and innovation-specific capacity. Motivation refers to the willingness and commitment of the staff to engage with and support the new intervention. General capacity includes the organizational capabilities, such as resources, infrastructure, and staff skills, that are necessary to implement any new intervention. Innovation-specific capacity pertains to the specific skills, knowledge, and resources required to effectively implement the OTIP.

Two types of qualitative interviews were conducted to evaluate the implementation approach: barriers to implementation interviews and facility champion leadership interviews. *The barriers to implementation interviews*, based on the Consolidated Framework for Implementation Research (CFIR)¹⁵ targeted two champions and two front-line midwives in each facility. The objective was to get information from the ground as the implementation was progressing to assess whether and how these barriers were being addressed by the champions. The data from these interviews were transcribed verbatim, coded into the CFIR domains, and analyzed through deductive thematic analysis. *The champion leadership interviews* were retrospective interviews intended to assess champions' perceptions of their roles and responsibilities, including participation in training programs, peer training efforts, and strategies for monitoring compliance with triage protocols: These were based on the Full Range Leadership Model including questions about both transactional and transformational leadership styles.¹⁶ Data collection involved audio recording the interviews (except for one participant who declined recording) and transcribing them verbatim. The transcripts were uploaded to Dedoose and Microsoft Word for qualitative analysis.

Learning Network Activities

Two types of cross-facility learning data were collected. A WhatsApp group linked the clinical champions of all the facilities to encourage informal communication to provide mutual support, to report on successful practices and to ask for assistance if needed. In addition, two formal learning network meetings were organized where the hospitals came together to report on implementation progress, successes and challenges. The first was held in hybrid format in December 2020 and the second was held in person in September 2021. For the purposes of evaluation, the WhatsApp data were downloaded for the evaluation but not analyzed because the communication was sporadic, often social, and did not lend itself well to systematic thematic analysis. For the learning network meetings, external rapporteurs were hired to produce formal reports, and these were reviewed for salient themes.

TAG Perception of Roles and Influence

Qualitative interviews were individually conducted with TAG members to understand their role in implementation and scale-up processes. A complete enumeration sampling approach was used, targeting all six members of the TAG (excluding the two

national champions) to ensure a comprehensive range of perspectives. In addition, minutes from the TAG meetings were reviewed to collect independent data on TAG activities.

Results

Clinical Outcome: Timeliness of Care

Timeliness of care significantly improved across the six participating hospitals as outlined in Table 1. At baseline, only 5% of women were assessed within 10 min of arrival across hospitals. Twelve months after the intervention, 85% of women were assessed within 10 min of arrival across hospitals.

Table 1
Women Assessed Within 10 Minutes of Arrival*

Nsawam	Baseline	3-months	6-months	12-months
	8/74 (11%)	69/72 (96%)	70/79 (89%)	74/82 (90%)
Ga South - Weija	2/78 (3%)	46/76 (61%)	47/74 (64%)	34/57 (60%)
Koforidua	6/75 (8%)	58/69 (84%)	39/60 (65%)	66/77 (86%)
Ga West	2/74 (3%)	54/61 (89%)	61/71 (86%)	70/83 (84%)
Bono Regional	1/50 (2%)	58/71 (82%)	67/81 (83%)	77/79 (97%)
Sunyani Municipal	3/51 (6%)	58/66 (88%)	68/73 (93%)	46/53 (87%)
Total	22/402 (5%)	343/415 (83%)	352/438 (80%)	367/431 (85%)

*Data are represented as numbers (percent). The number of charts sampled at each time interval ranged from 74 to 94; however, the arrival to assessment time difference could not be calculated if data were missing for either the arrival or the assessment times. Data represented exclude missing data.

Implementation Outcomes Results

Adoption

Wrist banding compliance remained high across facilities and post-implementation time periods and was sustained as shown in Table 2.

Table 2
Compliance in Wristband Administration*

Hospital	3-months	6-months	12-months	Combined
Nsawam	74/74 (100%)	81/81 (100%)	77/83 (93%)	232/238 (97%)
Ga South Weija	77/80 (96%)	67/79 (85%)	66/75 (88%)	210/234 (90%)
Koforidua	79/79 (100%)	72/74 (97%)	83/85 (98%)	234/238 (98%)
Ga West	72/74 (97%)	85/94 (90%)	88/91 (97%)	245/259 (95%)
Bono Regional	87/89 (98%)	89/89 (100%)	86/90 (96%)	262/268 (99%)
Sunyani Municipal	81/81 (100%)	90/90 (100%)	74/75 (99%)	245/246 (99%)
Total (%) Banded	470/477 (99%)	484/507 (95%)	474/499 (95%)	1428/1483 (96%)

*Data are represented as numbers (percent). The number of charts randomly sampled at each time interval ranged from 74 to 94. The data show the number of patients with wristband administration per sample.

Fidelity

Accuracy of risk categorization for the women administered a wristband was relatively consistent across facilities and over time as shown in Table 3.

Table 3
Accurate Assignment of Risk Banding Patients Across All Hospitals*

Hospital	3-months	6-months	12-months	Combined (%)
Nsawam	58/74 (78%)	66/81 (81%)	58/77 (75%)	182/232 (78%)
Ga South Weija	60/77 (78%)	53/67 (79%)	58/66 (88%)	171/210 (81%)
Koforidua	65/79 (82%)	54/72 (75%)	73/83 (88%)	192/234 (82%)
Ga West	58/72 (81%)	69/85 (81%)	68/88 (77%)	195/245 (80%)
Bono Regional	74/87 (85%)	82/89 (92%)	78/86 (91%)	234/262 (89%)
Sunyani Municipal	68/81 (84%)	77/90 (88%)	68/74 (92%)	213/245 (87%)
Total (%) Correct	383/470 (81%)	401/484 (83%)	403/474 (85%)	1187/1428 (83%)

*Data are represented as numbers (percent). The number of charts sampled at each time interval ranged from 74 to 94; however, the denominator excludes the patients who were not administered a wrist band.

Sustainability: There were 260 assessments using the NPT questionnaires conducted across facilities with Nsawam having 64 respondents, Ga South Weija 40 respondents, Koforidua 91 respondents, Ga West 55 respondents, Bono Regional 5 respondents, and Sunyani Municipal 5 respondents. The respondents included a diverse group of midwives, ward heads, physicians, and deputy directors of nursing services having varying lengths of employment, ranging from < 1 to > 15 years. Table 4 shows the average NPT assessment scores, categorized by the principal constructs. They are: *Coherence*, which evaluates the collective understanding and purpose of the intervention; *Cognitive Participation*, measuring the relational work that people do to ensure and sustain buy-in; *Collective Action*, assessing the operational work that is needed for sustainment and; *Reflexive Monitoring*, focusing on how people assess and appraise how the new practice affects them on an ongoing basis. Overall, 12 months after the intervention, healthcare workers understood the value of OTIP and had operationalized it, as indicated by the consistently high scores on Coherence and Collective action. The reflective and relational components had slightly lower scores, though this could be indicative of the concrete nature of the intervention and the implementation strategies, where the emphasis was on ensuring that the process was in place and implemented with fidelity.

Table 4
Average NPT Assessment Scores by Facility

Facility	Coherence	Cognitive Participation	Collective Action	Reflexive Monitoring	n (Number of Respondents)
Nsawam	4.36	4.01	4.36	4.06	64
Ga South Weija	4.29	3.93	4.33	3.98	40
Koforidua	4.23	3.85	4.27	3.95	91
Ga West	4.36	3.93	4.36	4.04	55
Bono Regional	4.35	3.96	4.32	4.02	5
Sunyani Municipal	3.35	2.85	4.08	5.00	5

Implementation Process Results: Within Facility

Facility Readiness Assessments

Midwives across hospitals completed 279 assessments in the weeks following the onsite training. Overall, across all domains (motivation, general capacity and innovation specific capacity), scores were high in all sites as shown in Table 5. Motivation to implement OTIP was uniformly high. There was more variability in the perception of general and implementation specific capacities across the sites, but only one site (Weija) reported an average score < 4 (3.56) on one domain (innovation specific capacity). Overall, the sites reported a high degree of readiness to implement OTIP.

Table 5
Readiness and Motivation Average Domain Scores for OTIP Implementation

Facility	R=MC2 Domain	R=MC2 Score
Ga West	General Capacities	4.18
	Innovation-Specific Capacities	4.13
	Motivation	4.63
Sunyani Municipal	General Capacities	4.22
	Innovation-Specific Capacities	4.19
	Motivation	4.56
Sunyani Regional	General Capacities	4.28
	Innovation-Specific Capacities	4.36
	Motivation	4.54
Weija	General Capacities	4.18
	Innovation-Specific Capacities	3.56
	Motivation	4.63
Koforidua	General Capacities	4.24
	Innovation-Specific Capacities	4.43
	Motivation	4.59
Nsawam	General Capacities	4.70
	Innovation-Specific Capacities	4.61
	Motivation	4.74

Barriers to implementation interviews

These were conducted in 2019 and then in early 2021 in four facilities (Weija, Nsawam, Koforidua, and Ga West). Two clinical champions and two front line staff were targeted in each facility. The intent was to conduct the interviews partway through the implementation process but for two facilities (Koforidua and Ga West), COVID-19 constraints necessitated waiting until March 2021 when the implementation was already sufficiently mature. Several challenges were identified, primarily resource constraints, logistical issues, and conflicts between regular job duties and triage responsibilities (for summary of all key themes, see Table 6). For example, the lack of a dedicated triage area and insufficient medical supplies often hindered the efficiency of the triage process. This is consistent with the results of the readiness and the NPT assessments. Overall, while staff were motivated, and remained motivated to triage patients even after the formal implementation had come to an end, system related operational constraints related to staff training and placement, resource availability and space were perceived as ongoing barriers.

Table 6
Implementation Barriers Using Key Themes

Key Themes	Quotes
Limited Space for Triage	"We don't know we have been inquiring [about additional space for triage], and when they [management] say when the time is coming to help us to do it, they will help us to do it. We are just managing, but we are hoping there will be a remedy."
Inconsistent Equipment Availability	"Sometimes we don't have enough BP machines, thermometers, or beds to accommodate all the mothers who need urgent assessment."
Need For Additional Training	"Offer refresher courses on triage process and scale OTIP to all facilities across Ghana."
Initial Learning Curve for Triage Process	"A new thing is always hard but they [triage] have been good. It took awhile at first, but after that it has been fine. It helps with the diagnosis and care plan."
Challenges in Prioritizing Patients During Peak Hours	"Sometimes, when there are too many patients, we struggle to decide who to prioritize first, especially when symptoms are not immediately clear."
Limited Staffing for Triage Implementation	"During night shifts, it can be difficult because there are fewer of us on duty, and triage takes additional time."

Facility Champion Leadership Interviews

The leadership interviews were conducted in late 2019 and early 2020. Of the 14 triage champions, 9 were interviewed (2 were on leave and 3 were no longer clinical champions at the time of the interviews). Summarized results are shown in Table 7. A primary strategy was to enable the clinical champions to identify implementation challenges in their facilities, and to develop and test solutions following an iterative QI-based problem solving approach. Training was provided on the approach, but its use and documentation was not mandated. As a result, it was difficult to match actual strategies used by the champions to address specific barriers. The results from the leadership interviews provided a holistic perspective of how the champions functioned as active leaders within their facilities to support the implementation as it progressed. The assessment of leadership styles among the clinical champions was primarily transformational. Champions provided support and mentorship through active coaching and one-on-one communication to address capability gaps among midwives, which significantly improved the triage accuracy and fostered a supportive environment. They leveraged their positions to influence and motivate their peers, creating a sense of purpose and priority. For instance, champions engaged with midwives who struggled by offering personalized training and support. In addition, champions encouraged collaboration, creative problem-solving and critical thinking among the staff. Champions regularly held meetings and training sessions to discuss challenges and best practices, fostering an environment of continuous improvement. Inspirational motivation was also a key aspect, where champions energized their teams by highlighting the importance of their work and its impact on maternal health outcomes.

In addition, the staff training sessions conducted across participating hospitals revealed that several sites made adaptations to address specific local needs and constraints. For example, one facility adjusted the delivery format by conducting shorter, more frequent training sessions during shift changes to ensure participation from all staff. Another facility created a triage "area" rather than a single, separate room due to infrastructure constraints. Additionally, some sites changed the wristband color to orange from red due to the spiritual connotations associated with the color red. These adaptations highlight how facilities leveraged local knowledge and context to optimize the training for successful implementation.

Table 7
Champions Leadership Style Interviews Key Themes

Key Themes	Quotes
Overall Leadership	"Having good communication and interpersonal relationships is important... if work is not done sometimes, they will do it."
Relationships and Collaboration	"We see each other on [a] day to day basis; we do have morning, afternoon, and night shifts, so we do communicate. There is always someone to call with a question. Besides that, our team leader is around and can always pick up the phone and call to ask."
Adoption, Adaption, and Innovation	"I developed my own form from triaging... I developed a form to check [a] baby's vital signs and things the mothers have to talk about before they go home for midwives."
Support, Mentor, and Coach	"I usually call them [the midwives'] on the phone or send a WhatsApp message asking how you are doing or check up on them."
Rewards and Motivation	"The fact that triage produces positive results and my name is associated with the program is very satisfactory."
Challenges	"Management knew that we had to set up the triage unit but we had to do a lot of pushing to get resources to get it on. I think somehow for facilities the managers of the facilities determine what is the priority... and initially the managers in our place did not see triage as a priority – so we had to do a lot of talking, a lot convincing to get them to do it and do it quickly."

Implementation Process Results: Cross Facility

The rapporteur summaries of the learning network meetings reiterated the positive and negative aspects of the implementation identified in the facility level interviews. Motivation and enthusiasm for the program remained generally high, but common systemic barriers to implementation were reported in all hospitals to a greater or lesser extent. A summary of the first meeting by one of the session chairs identified *"champions' unavailability due to attrition affected the continuation of triaging, champions' poor attitude in terms of not completing the triage assessment forms, inaccurate banding, unsupportive management, inadequate space and equipment for quality triage and the non-involvement of the quality improvement teams at the facilities"* as common barriers across all hospitals. These barriers to implementation had not disappeared by the time of the second meeting. For example, in the individual facility level presentations about the process of implementation, one facility reported *"the frequent breakdown of equipment due to huge numbers [of patients] visiting OBGYN"*. Another indicated that *"frequent breakdown of equipment, change of staff and posting of new staff to the unit and poor banding compliance were amongst the challenges the unit faced"*. A third mentioned *"a frequent breakdown of equipment, re-triaging of clients on admission and poor counselling of patients on color banding"*.

From an implementation perspective, the learning network meetings did not provide major breakthroughs to address systems level challenges. However, the meetings were opportunities to share facility-level strategies to surmount barriers and to acknowledge that some challenges required higher level involvement. The participation of key GHS leaders allowed discussion of these issues as well as sustainability and scale up. At the end of the second conference, the GHS Institutional Care Division representative mentioned that there was interest in scaling OTIP and invited facilities to share their experiences in implementing the intervention despite barriers and scarce resources.

Implementation Process Results: Health System Level

TAG Interviews

Five interviews were conducted in May of 2022, with three interviews conducted in person and two remotely via Zoom. One member did not respond to the request for interview. The TAG members emphasized the importance of the group's diverse expertise, which included obstetricians, health systems experts, researchers, and midwives. As one of the members said, *"OTIP brought together a unique blend of multidisciplinary experts—obstetricians, health systems specialists, and researchers—who applied their diverse skills to strengthen the program."* The overall perspective of TAG members is that they played a crucial role in providing technical, administrative and leadership support.

Discussion

Overall, the results indicate that OTIP implementation was successful and that triage was largely integrated into the daily facility workflow. An important question for the field of implementation science is the extent to which the implementation theory shown in Figure 1 was responsible for the achievement of results. To assess this, we answer the evaluation questions sequentially, using the evaluation results. As a guiding approach to synthesize the diverse results of this evaluation, we employ Contribution Analysis (CA)¹⁷. CA attempts to use available evidence to create an integrated contribution “story” based on evidence about how interventions lead to outcomes, using INUS (Insufficient but Necessary parts of an Unnecessary but Sufficient Condition) rather than counterfactual logic. INUS logic looks for factors that are necessary (without which the outcome cannot be achieved), but by themselves are not sufficient (other factors also need to be present). By identifying factors that explain the outcomes, and by establishing that these factors were present during the intervention, INUS logic offers a stronger causal argument than qualitative research methods that rely on thematic interpretation. We use this logic to describe plausible causal mechanisms through which the key implementation outcomes of adoption, fidelity and sustainment were achieved, using the core ingredients of the implementation theory.

1) To what extent did the obstetric triage program achieve its clinical and implementation outcomes and how were these outcomes sustained after implementation was complete?

It is possible to state that OTIP achieved and sustained its outcomes. As shown in **Tables 1-3**, improvements in clinical and implementation outcomes were sustained for 12 months following the intervention.

2) To what extent were the components of the implementation theory used in guiding the implementation process?

The core components of the implementation theory were: (a) the use of champions to lead and adapt on-site, local training; (b) the adaptations of the intervention to site context; (c) the monitoring and coaching strategy employing champions as transformational leaders trained in QI; (d) involvement of facility leadership, national champions and TAG and (e) cross-facility learning, informally through WhatsApp and formally through organized learning networks. Each of these components was used to develop the implementation approach, and the evaluation results indicate that each of them played a role in contributing to the success of the implementation though it is difficult to estimate the individual contribution of each component.

3) How effective was this theory in accelerating and sustaining the implementation of obstetric triage? What were the mechanisms by which this occurred?

This question contains two hypotheses. The first concerns the pace of implementation. We hypothesized that by using structured problem-solving methods and allowing local adaptation, successful implementation strategies could be shared among facilities, thus accelerating knowledge spread, fidelity and adoption. Our theory posited that through sharing best practices at the learning network, adoption would be faster in facilities where implementation occurred later. Unfortunately, we were unable to answer this question because the COVID-19 disrupted a smooth and sequential implementation.

Adoption: As shown in **Table 2**, adoption, measured by the percentage of patients who received a wristband after assessment, was 96% across all sites and assessment time periods. The qualitative results indicate that *leadership support*, at the facility and TAG level, and the *active involvement of champions* were necessary for success. Pre-implementation site visits provided a project overview and an opportunity to garner leadership support. The TAG provided the official GHS letters of engagement to the selected sites and guidance on system level problems. Local leaders addressed logistical issues, such as creating triage areas, and provided supplies such as wristbands and triage forms. During implementation, every facility faced some degree of difficulty that required leadership support. Although leadership engagement was variable, as reflected in the organizational readiness scores, it is reasonable to conclude that without leadership participation, OTIP would not have been adopted.

Leadership engagement alone, however, was insufficient for successful adoption. Adoption required consistent focus by midwife champions to ensure that patients received wristbands and to provide reinforcement and reminders when they did not. This task was undertaken by the champions, who as indicated in the thematic leadership interviews, used their leadership

positions and interpersonal skills to ensure wristband compliance. Without their consistent involvement, OTIP adoption would have fallen short. In summary, leadership support and champion involvement were both necessary but not individually sufficient. A package of leadership support to address facility level barriers and champions to encourage and enforce at the ward level were *jointly* needed to ensure adoption of the OTIP intervention.

Fidelity: As shown in **Table 3**, fidelity, measured as the percentage of patients who received an accurate wristband, commensurate with their risk, was 83% averaged across sites and assessment time periods. The evaluation results indicate that the *active involvement of champions* and the *monitoring activities* were each necessary and sufficient together to achieve this implementation outcome. Champions played a transformative role as motivators, facilitators, and problem-solvers within facilities. Their leadership qualities, including transformational traits such as vision-setting, team cohesion, and mentorship, enabled them to inspire staff and address barriers to adoption. Monitoring systems provided data on implementation progress, highlighting what was working and what wasn't. Alone, champions lacked the monitoring capabilities to pinpoint problems and to test solutions to address them. Similarly, monitoring systems without champions—the human element driving engagement and problem-solving—were unable to translate data into meaningful action. Together, these components created a virtuous cycle: monitoring systems offered actionable insights, which champions leveraged to motivate staff, refine workflows, and ensure fidelity to the intervention.

Sustainment: While adoption and fidelity required action at the individual facility level, cross facility and health system components of the theory of change are necessary for sustainment. The *problem solving cycles* at each site were necessary to improve local adoption and fidelity as were *learning network sessions* that disseminated successful solutions by providing a platform for sharing knowledge, fostering collaboration, and building collective expertise across facilities. Problem-solving activities alone could not achieve credibility without a mechanism for broader knowledge exchange, and learning networks alone are not useful without actionable insights from local problem-solving efforts. When combined, these elements created a robust pathway for collaborative learning and joint accountability.

Finally, at the system level, sustaining outcomes required the combined efforts of *champions* and *TAG support*. Champions addressed day-to-day challenges within facilities, ensuring that implementation barriers were identified and resolved. Their close engagement with staff and operational workflows allowed them to maintain momentum and address emerging issues effectively. TAG members, on the other hand, tackled systemic barriers that extended beyond the facility level, such as advocating for policy changes, ensuring facility-level leadership engagement and alignment with national health priorities. They played a valuable advisory role and facilitated communications. The fact that the two national champions were TAG members also ensured that the TAG was informed of the nuts and bolts of the operations of OTIP. Several TAG members attended and chaired sessions at the learning network meetings, making their support and involvement visible to the facility leadership and staff. Champions alone, while critical for local success, could not resolve broader systemic challenges like resource allocation gaps or regulatory hurdles. Conversely, TAG support without the contextual insights of champions lacked the grounded perspective needed to make informed decisions. Together, these components formed a comprehensive sustainability approach. This dynamic interplay between local leadership and system-level advocacy created the conditions necessary for sustaining OTIP outcomes.

4) To what extent did the theory result in changes beyond the level of individual facilities (e.g., changing norms or policy across multiple facilities)?

The intentional multilevel approach to the theory that included leaders from the GHS as necessary ingredients of the implementation approach allowed visibility of the program and its success at national levels. The explicit appointment of front-line staff who were directly involved in facility-level program as national champions enabled the dissemination of the OTIP to other facilities in the country. Currently, OTIP is being implemented in 76 referral facilities nationwide, encompassing 64% of Ghana's institutional births, using 16 national trainers.

5) What insights garnered from this specific implementation theory can be generalized to other settings, helping to define a mid-range theory about the implementation of evidence-based interventions in new settings?

Developing theory requires an iterative “theorizing” process, whereby the best existing theory is strengthened and reinforced with data related to its use in actual contexts.¹⁸ The theory of change shown in Figure 1 evolved through earlier versions used in pilot obstetric triage implementations reported earlier.^{5,19} Here, we have tested this theory on the OTIP implementation and identified plausible pathways through which aspects of this theory resulted in successful program implementation. Our results indicate the following requirements for mid-range theory of successful implementation of complex interventions in low resource settings: (a) multilevel, encompassing facilities and the health systems; (b) champions at both levels who are trained not only on the intervention but also on the basics of implementation science; (c) data on key implementation outcomes should be readily available to monitor progress and to improve and (d) mechanisms for sharing successful practices to facilitate uptake and sustainment.

Contribution to the Literature

- There is a need to improve the quality of theories of implementation and the process of developing and testing implementation theories. This paper is a concrete example of the theorizing process that demonstrates how an initial theory of change can be tested, refined and expanded using program evaluation data.
- Implementation of programs at scale almost universally involves complex, multi-component interventions implemented using multi-level, multi-faceted implementation strategies. There are no standard methods to evaluate such programs. This study demonstrates the use of Contribution Analysis (CA) for combining complex mixed-methods data to make plausible causal arguments.
- This study provides a practical demonstration of how a program theory can drive the formulation of appropriate research questions that can guide the selection of relevant frameworks and instruments (e.g. organizational readiness, CFIR, NPT, leadership questionnaires) to be used in an integrated way to collect data about the implementation process.

Limitations

While this study provides valuable insights into the implementation of OTIP, several limitations should be acknowledged. First, the COVID-19 pandemic posed significant constraints on implementation timelines, affecting factors such as baseline data collection, training and learning network programming. Online platforms were employed, when appropriate, as a mitigation factor to travel restriction. The COVID-19 disruptions deprived us of the opportunity to accurately assess whether a multilevel implementation theory not only influences quality but also the pace of implementation. With the current emphasis on research on pace, this is an unfortunate but uncontrollable limitation.

Second, our analysis focused primarily on the roles of TAG and champions, potentially underrepresenting the contributions of other facility leadership, such as ward in-charges. These individuals often acted as intermediaries, bridging champions’ on-the-ground efforts with TAG’s system-level support. However, their roles were not comprehensively explored, which may limit the generalizability of our findings regarding multi-level support structures within OTIP and similar health interventions. Future research should examine the broader spectrum of leadership roles to capture a more holistic picture of the support dynamics at play.

Finally, the reliance on qualitative data from interviews and self-assessments introduces the potential for bias. Participants’ perceptions of their roles and effectiveness may not fully align with actual practice, and this discrepancy could influence the interpretation of findings. Triangulation of quantitative clinical outcome data with the qualitative results provide a degree of confidence that the qualitative perceptions are aligned with the objectively observed results, but do not completely eliminate the possibility of misinterpretation.

Declarations

Ethics approval and consent: The study was granted Institutional Review Board approval by Wake Forest University Health Sciences, Winston-Salem, North Carolina (IRB#00058386)

and administrative approval from the Ghana Health Service, Accra, Ghana (GHS/DG5/23-4-19). The study qualified for expedited review and met the criteria to waive informed consent.

Consent for publication: Not applicable.

Availability of data and materials: The datasets collected and analyzed during the current study will be available from the corresponding author on reasonable request.

Competing interests: MDO and RR declare that they have subcontracts from Kybele-Ghana. Other authors declare no competing interests.

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Authors' contributions: SM, CRW and SB contributed to study conception and design, were involved as primary drafters and editors of the manuscript, gave final approval to this version, and agreed to be accountable for the accuracy and integrity of the work. MO contributed to study conception and design, was heavily involved with data collection, data entry and data analysis, manuscript revision, gave final approval to this version, and agreed to be accountable for the accuracy and integrity of the work. MEA, EKS, SD, CT, MB, and GB made significant contribution to study execution, manuscript editing, gave final approval to this version, and agreed to be accountable for the accuracy and integrity of the work. FB made significant contribution to data analysis, manuscript editing, gave final approval to this version, and agreed to be accountable for the accuracy and integrity of the work. RR made significant contribution to study conception and design, was involved with revising the manuscript for each draft, gave final approval to this version, and agreed to be accountable for the accuracy and integrity of the work. All authors have read and approved the final version of this manuscript.

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References

1. World Bank. World Bank Open Data. <https://data.worldbank.org/>. Accessed February 12, 2026.
2. Boerma T, Campbell OMR, Amouzou A, Blumenberg C, Blencowe H, Moran A, Lawn JE, Ikilezi G. Maternal mortality, stillbirths, and neonatal mortality: a transition model based on analyses of 151 countries. *Lancet Glob Health*. 2023;11(7):e1024–31.
3. Thaddeus S, Maine D. Too far to walk: maternal mortality in context. *Soc Sci Med*. 1994;38(8):1091–110.
4. Goodman DM, Srofenyoh EK, Olufolabi AJ, Kim SM, Owen MD. The third delay: understanding waiting time for obstetric referrals at a large regional hospital in Ghana. *BMC Pregnancy Childbirth*. 2017;17(1):216.
5. Goodman DM, Srofenyoh EK, Ramaswamy R, Bryce F, Floyd L, Olufolabi A, Tetteh C, Owen MD. Addressing the third delay: implementing a novel obstetric triage system in Ghana. *BMJ Glob Health*. 2018;3(2):e000623.
6. Williams CR, Bogdewic S, Owen MD, Srofenyoh EK, Ramaswamy R. A protocol for evaluating a multi-level implementation theory to scale-up obstetric triage in referral hospitals in Ghana. *Implement Sci*. 2020;15(1):31.
7. Floyd L, Bryce F, Ramaswamy R, Olufolabi A, Srofenyoh E, Goodman D, Pearson N, Morgan K, Tetteh C, Ahwireng V, Owen M. The introduction of a midwife-led obstetric triage system into a regional referral hospital in Ghana. *Midwifery*. 2018;61:45–52.
8. Roper M, Rooney K. The model for improvement: A tool to drive perioperative improvement. *Perioperative Qual Improv*. 2023;131–6.

9. Bell S, Blanchard L, Wells H, Mounier-Jack S, Howard N. Value and effectiveness of National Immunization Technical Advisory Groups in low- and middle-income countries: a qualitative study of global and national perspectives. *Health Policy Plann.* 2019;34(4):271–81.
10. Curran GM, Bauer M, Mittman B, Pyne JM, Stetler C. Effectiveness-implementation hybrid designs: combining elements of clinical effectiveness and implementation research to enhance public health impact. *Med Care.* 2012;50(3):217–26.
11. Creswell JW, Creswell JD. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches.* 6th ed. Los Angeles: SAGE Publications Inc., c2023. Chapter 10, Mixed methods procedures; pp. 227 – 62.
12. Murray E, Treweek S, Pope C, MacFarlane A, Ballini L, Dowrick C, Finch T, Kennedy A, Mair F, O'Donnell C, Ong BN, Rapley T, Rogers A, May C. Normalisation process theory: a framework for developing, evaluating and implementing complex interventions. *BMC Med.* 2010;8:63.
13. Scaccia JP, Cook BS, Lamont A, Wandersman A, Castellow J, Katz J, Beidas RS. A practical implementation science heuristic for organizational readiness: $R = MC^2$. *J Community Psychol.* 2015;43(4):484–501.
14. Domlyn AM, Wandersman A. Community coalition readiness for implementing something new: Using a Delphi methodology. *J Community Psychol.* 2019;47(4):882–97.
15. Damschroder LJ, Reardon CM, Widerquist MAO, Lowery J. The updated Consolidated Framework for Implementation Research based on user feedback. *Implement Sci.* 2022;17(1):75.
16. Avolio BJ, Bass BM. *Developing Potential Across a Full Range of Leadership: Cases on Transactional and Transformational Leadership.* New York: Psychology; 2002.
17. Mayne J. Contribution analysis: An approach to exploring cause and effect. Institutional Learning and Change Initiative. ILAC Briefs. 2008;16:1–4. Available at: https://www.researchgate.net/publication/46472564_Contribution_analysis_An_approach_to_exploring_cause_and_effect. Accessed December 29, 2025.
18. Kislov R. Engaging with theory: from theoretically informed to theoretically informative improvement research. *BMJ Qual Saf.* 2019;28:177–9. <https://doi.org/10.1136/bmjqs-2018-009036>.
19. Ramaswamy R, Bogdewic S, Williams CR, Deganus S, Bonzi GA, Boakye J, Koranteng E, Mensah R, Amanor A, Bryce F, Owen MD. Implementation matters: assessing the effectiveness and sustainment of an obstetric triage program at a high-volume facility in Ghana. *Implement Sci Commun.* 2023;4(1):138.
20. Moore GF, Audrey S, Barker M, Bond L, Bonell C, Hardeman W, Moore L, O'Cathain A, Tinati T, Wight D, Baird J. Process evaluation of complex interventions: Medical Research Council guidance. *BMJ.* 2015;350:h1258.
21. Hill LG, Cooper BR, Parker LA. Qualitative Comparative Analysis: A Mixed-Method Tool for Complex Implementation Questions. *J Prim Prev.* 2019;40(1):69–87.
22. Whitaker RG, Sperber N, Baumgartner M, Thiem A, Cragun D, Damschroder L, Miech EJ, Slade A, Birken S. Coincidence analysis: a new method for causal inference in implementation science. *Implement Sci.* 2020;15(1):108.
23. Sarkies MN, Francis-Auton E, Long JC, Pomare C, Hardwick R, Braithwaite J. Making implementation science more real. *BMC Med Res Methodol.* 2022;22(1):178.

Figures

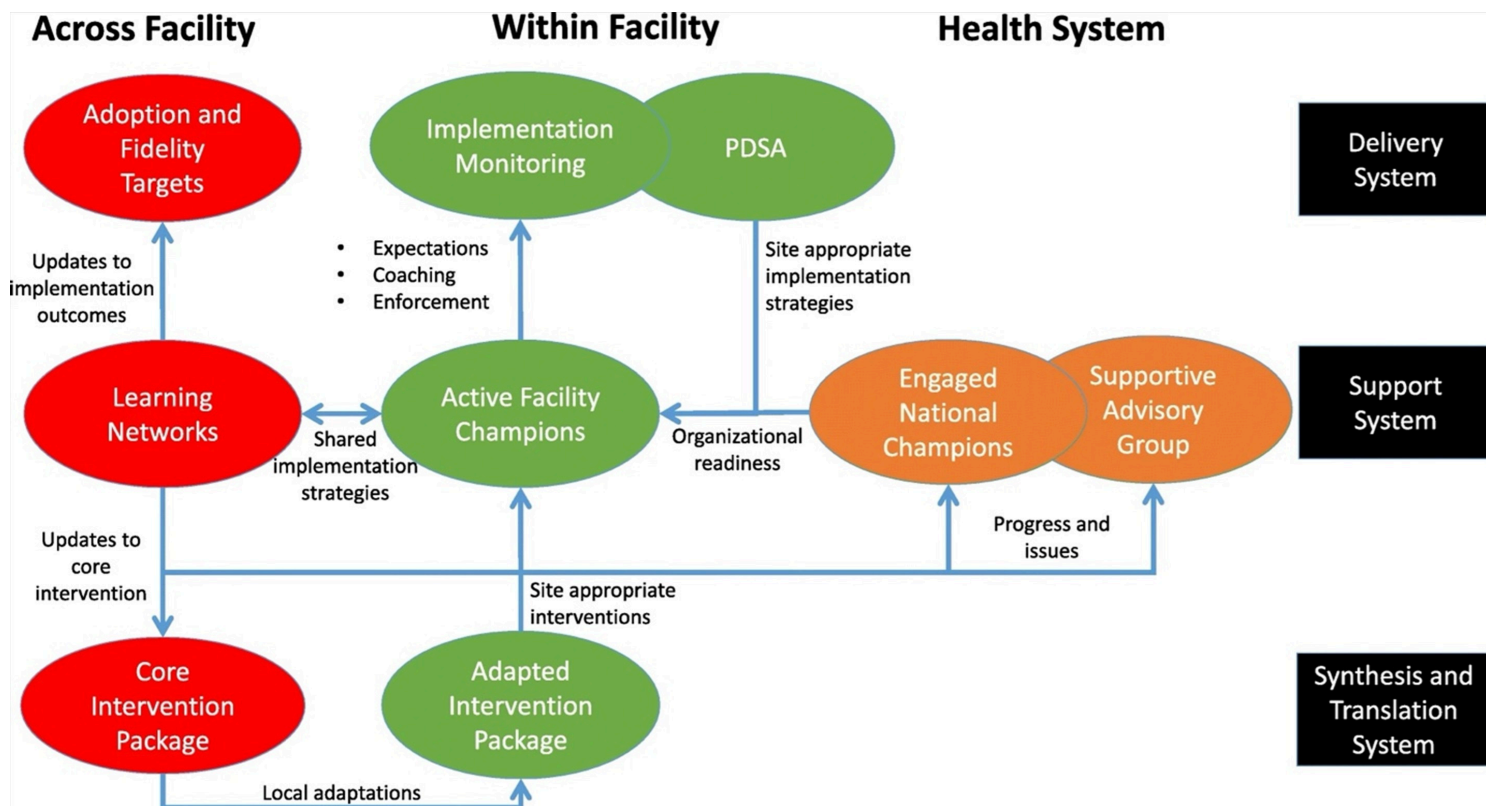


Figure 1

OTIP Theory of Change