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Improving surgical quality in low-income and middle-income countries: why do some health facilities perform better than others?

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ABSTRACT

Background Evidence on heterogeneity in outcomes of surgical quality interventions in low-income and middle-income countries is limited. We explored factors driving performance in the Safe Surgery 2020 intervention in Tanzania's Lake Zone to distil implementation lessons for low-resource settings.

Methods We identified higher (n=3) and lower (n=3) performers from quantitative data on improvement from 14 safety and teamwork and communication indicators at 0 and 12 months from 10 intervention facilities, using a positive deviance framework. From 72 key informant interviews with surgical providers across facilities at 1, 6 and 12 months, we used a grounded theory approach to identify practices of higher and lower performers.

Results Performance experiences of higher and lower performers differed on the following themes: (1) preintervention context, (2) engagement with Safe Surgery 2020 interventions, (3) teamwork and communication orientation, (4) collective learning orientation, (5) role of leadership, and (6) perceived impact of Safe Surgery 2020 and beyond. Higher performers had a culture of teamwork which helped them capitalise on Safe Surgery 2020 to improve surgical ecosystems holistically on safety practices, teamwork and communication. Lower performers prioritised overhauling safety practices and began considering organisational cultural changes much later. Thus, while also improving, lower performers prioritised different goals and trailed higher performers on the change continuum.

Conclusion Future interventions should be tailored to facility context and invest in strengthening teamwork, communication and collective learning and facilitate leadership engagement to build a receptive climate for successful implementation of safe surgery interventions.

INTRODUCTION

Access to quality surgical care remains a critical gap in low-income and middle-income countries (LMICs).[1 2] Perioperative and anaesthetic mortality is over twice that of high-income countries (HICs) and largely attributed to common procedures like caesarean sections, surgical injuries and anaesthesia-related complications.[3] Postsurgical infections also contribute to high morbidity and mortality.[4] For caesarean sections, postsurgical infections are estimated at 3%–24% in LMICs, compared with 3%–11% in HICs.[4] Advancing surgical quality in LMICs is therefore a pressing global health concern.[5]

Recent evidence suggests surgical quality interventions with multiple components have heterogeneous

performance outcomes between and within facilities.[6] Many studies have reported variable implementation of widely used tools such as the WHO Surgical Safety Checklist (SSC) and in the control of surgical site infections (SSI).[7] However, there is limited evidence on the implementation experiences that may be driving performance heterogeneity.[8] Since surgical providers contribute significantly to the shape and form of quality improvement interventions in different facilities, their experience can be critical in understanding variability in facility performance.[9] This in turn is critical for improving and scaling interventions, as well as ensuring their replicability and sustainability.[7 9]

We used the positive deviance framework recommended by Bradley *et al*[6 8] to undertake a detailed qualitative analysis of provider experiences to understand factors driving facility level variations in the performance of Safe Surgery 2020 (SS2020), a surgical quality intervention based in Tanzania's Lake Zone.[10] SS2020 sought to improve adherence to safety practices, teamwork, communication and completeness of documentation in patient records in the short term. Its medium-term goals included reduction of postsurgical infections, including SSI, sepsis and maternal sepsis.[10] We had the following specific aims: to identify higher-performing facilities based on predetermined SS2020 metrics; to use qualitative analysis to compare the implementation experiences of higher-performing and lower-performing facilities; and to distil lessons for safe surgery interventions that may be applied to other low-resource settings.

METHODS

Study design

We designed a qualitative study using a positive deviance framework[8] to explore factors distinguishing higher-performing and lower-performing facilities in the SS2020 intervention. Positive deviance analysis can improve quality by highlighting the best practices of organisations that demonstrate exemplary performance under similar constraints.[8 11] While the approach focuses on higher performers, we also studied lower performers for rich learning[12] and insight on scaling surgical quality. To ground the results in data and minimise confirmation bias, the research team was blinded to performance during data collection, coding and initial data analysis.[11 13] We followed the Consolidated criteria for Reporting Qualitative research.[14]

Setting and intervention

Our setting included 10 SS2020 intervention facilities located in Tanzania's Mara and Kagera regions. The population is largely rural (59%) and below the poverty line (49.1%).[15] The 10 facilities included regional hospitals, district hospitals and health centres (table 1).

The multicomponent SS2020 intervention was implemented in three phases (figure 1). The first phase focused on changing organisational culture through engaging surgical teams in a week-long training on leadership, teamwork and communication. The second phase focused on building capacity in evidence-based practices in safe surgery and anaesthesia, equipment sterilisation and data quality. The third phase, which is ongoing, focuses on facilitating the sustainability of the first and second phase through inperson and virtual mentorship using the Project ECHO platform,[16] the Touch Surgery smartphone application with videos of surgical procedures,[17] and infrastructure support through a grant of up to US$10 000 per facility and a perioperative equipment package.

Table 1 Characteristics of intervention facilities and respondents, 2019

Facility characteristics	Higher performers	Middle performers	Lower performers
Number of beds			
40–150	4	2	
150–400		1	3
Number of operating rooms			
Major	5	5	6
Minor	5	3	3
Ownership			
Public	3	2	2
Public, mission		1	1
Private, mission	1		
Geography			
Rural	3	2	
Urban		1	2
Suburban	1		1
Respondent characteristics			
Respondent role			
Facility leader	11	5	7
Surgical team leader	6	5	5
Surgical provider	6	5	7
Anaesthetist	10	5	8
Nurse	8	10	6
Other	0	1	0
Total	41	31	33
Years of experience in present role*			
<5	20	21	19
5–10	10	6	8
>10	4	2	1

*Years of experience was not collected for 14 respondents.

Sample and data collection

We conducted 101 interviews with 105 providers at the 10 facilities at 1 month (baseline), 6 months (midline) and 12 months (endline) following the start of the SS2020 intervention (figure 1). We purposively sampled a facility leader and two or three surgical team members identified by the facility to obtain diversity in perspectives, maximise theoretical saturation[18–20] and

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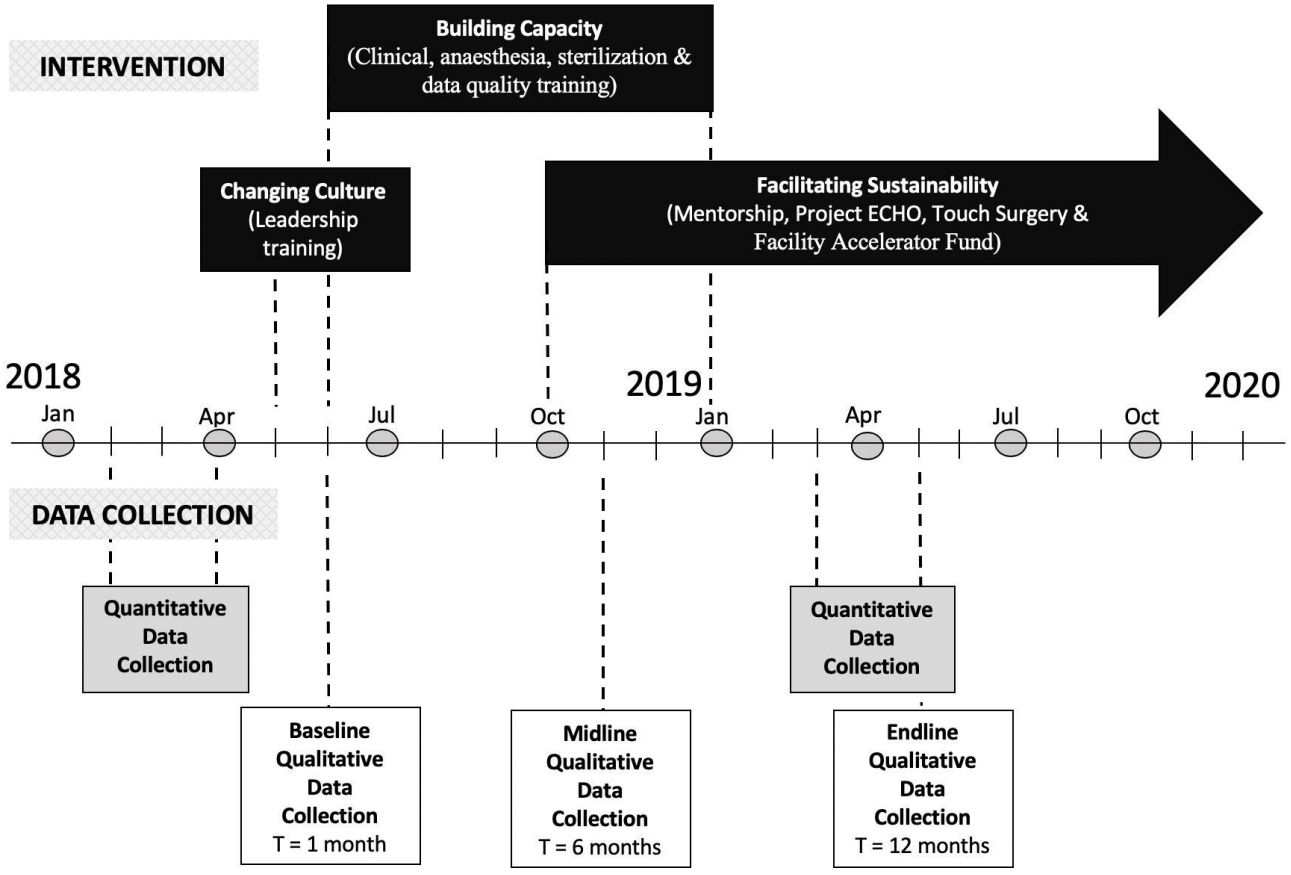

Figure 1 SS2020 Tanzania intervention and data collection timeline. SS2020, Safe Surgery 2020.

validate information from multiple sources (table 1). The hour-long interviews were semistructured and conducted in a private space by two research team members (SA and AM or MS) in English. SS2020 Tanzanian physician data collectors familiar with the local context set up interviews and provided Swahili translation when needed.[10] SA holds a doctoral degree in health policy and management with experience in surgical quality and implementation science research. AM was a medical student and MS holds a Master's in Public Health; both were research assistants.

Three semistructured longitudinal interview guides (online supplemental appendix 1) to understand providers' experiences with SS2020 were developed based on experience from SS2020 implementation in Ethiopia, exploratory fieldwork in Tanzania and input from SS2020 partners, supplemented with literature on implementation of interventions.[21–24] The interviews explored visions for safe surgery, the surgical team's buy-in, facility's approach to implementation including leadership engagement, facilitators and barriers to implementation, and lessons learnt. Verbal consent was obtained before each interview. No interviewees declined to participate or asked to stop. The interviewers maintained detailed field notes that were updated daily. The interviews were transcribed from taped recordings and imported into NVivo V.11 (QSR International, Melbourne, Australia) for coding. The accuracy of transcription was verified by proofing a random sample of transcripts.

Identification of higher-performing and lower-performing facilities

We used SSC adherence to identify higher-performing and lower-performing facilities since evidence demonstrates its correct use can reduce postsurgical infections,[25–27] improve teamwork,[28–30] promote a safety culture[28] and reduce mortality.[25 31 32] We did not use postsurgical infection rates because baseline cases were low and therefore the difference between preintervention and postintervention rates was not a robust measure of performance.

We developed a composite index of 14 safety and teamwork and communication indicators based on scientific literature[29 31 33–38] (online supplemental appendix 2). We trained Tanzanian medical data collectors in the identification and classification of study measures and placed one data collector at each facility for 3 months preintervention and 3 months postintervention. The data collectors observed surgeries using an adapted SSC observation tool[39] and recorded surgical teams' adherence to safety and teamwork and communication measures.

A review of the literature demonstrated no standardised cut-offs for high and low performers related to the SSC.[25–27 35 39–43] Thus, we used change in

Table 2 Improvement in average adherence on a composite index of 14 safety and teamwork and communication indicators from preintervention to postintervention based on quantitative indicators

	Average adherence to safety and teamwork and communication indicators on the composite index (%)		Average improvement in percentage points
	Baseline	Endline	
Higher-performing facilities			
Facility 1	19	95	76
Facility 2	18	92	74
Facility 3	9	74	65
Facility 4	13	73	60
Middle-performing facilities			
Facility 5	10	59	49
Facility 6	11	55	44
Facility 7	5	41	36
Lower-performing facilities			
Facility 8	8	39	31
Facility 9	14	44	30
Facility 10	15	34	19

percentage points from preintervention to postintervention on the composite index to identify higher and lower performers. Performance was characterised using preintervention data collected from February to April 2018 and postintervention data collected from March to May 2019. Higher-performing facilities (n=4) were defined as intervention facilities with improvement above 60 percentage points on the composite index. The four top-performing facilities improved by 76, 74, 65 and 60 percentage points from preintervention to postintervention, respectively. We defined lower-performing facilities (n=3) as those with improvement below 35 percentage points on the composite index. They improved by 31, 30 and 19 percentage points, respectively (table 2). We eliminated middle performers (facilities 5, 6 and 7). We eliminated facility 3 (higher performer) from analysis since it only had 18 SSC observations during the postintervention period, compared with an average of 221 SSC observations per facility.

Distinguishing practices of higher-performing and lower-performing facilities

We used a grounded theory approach to factors distinguishing higher-performing from lower-performing facilities.[44–46] Grounded theory is a systematic, inductive approach to generate themes reflecting the perspectives of interview participants. Our data analysis unfolded in successive stages, using the constant comparison method.[18 47] First, the research team (PC, NZ, SA, AM) reviewed three different transcripts each and had discussions to arrive at a unified preliminary codebook. The four coders tested the unified codebook on the same two transcripts separately, coming together to compare their coding after each transcript. This process allowed the merging of similar codes and fine-tuning code definitions, until no new codes emerged, that is, we reached theoretical saturation.[18–20] Any disagreements in coding were resolved through discussion. The inter-rater reliability was found to be kappa=0.85 ('almost perfect agreement').[48] The research team then divided the coding of the 101 transcripts (NZ 42%, PC 36%, AM 16%, SA 6%). All transcripts were de-identified, labelled with alphanumeric code and randomly assigned. After completing the coding, the team identified themes emerging from the data while still remaining blinded. Then, unblinded, we compared key themes across higher-performing and lower-performing facilities to identify distinguishing practices including deviant cases.[8 49]

RESULTS

Higher performers were facilities with 40–150 beds and publicly owned, barring one faith-based organisation. Lower-performing facilities were larger (150–400 beds) and all publicly owned (table 1). Six themes and 14 constituent subthemes emerged from experiences of higher-performing and lower-performing facilities (table 3, online supplemental appendix 3). Since all facilities showed substantial improvement in surgical practices (table 2), 'higher' and 'lower' performance refers to relative differences in experiences. Quotes are edited for language and flow.

Preintervention organisational orientation

Facility characteristics

Providers in higher-performing and lower-performing facilities expressed constraints including staff shortage, inadequate infrastructure and poor infection control. Higher performers discussed these weaknesses as demoralising and detrimental to team relationships and surgical outcomes; lower performers described them as barriers to clinical goals.

Team orientation

Higher performers had a strong prior culture of teamwork, with references to surgery as a team effort, collective problem-solving and support of coworkers. They capitalised on SS2020 to further strengthen teamwork. Lower performers were less teamwork-oriented before SS2020. While individual providers in these facilities saw SS2020 as an opportunity to improve skills for better patient care, team improvement was not expressed as a target in itself.

Higher performer

> We work as a team. We were using a problem solution tree before SS2020. If there was an issue, team members came together, suggested solutions and picked solutions which scored highest and were easiest

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Table 3 Description of themes and subthemes on performance experiences of higher-performing and lower-performing facilities

Themes	Subthemes	Description
Preintervention context		Facility's preintervention context.
	Facility characteristics	Preintervention physical infrastructure as described by providers.
	Team orientation	Preintervention perceived team relationships.
	Learning orientation	Preintervention perceived organisational learning strategies, extent of experimentation and willingness to learn from others.
Engagement with SS2020 intervention		Engagement and learning from the SS2020 intervention.
	Leadership and SSC training	Postintervention perceived learnings from the leadership training intervention, particularly in the implementation of the SSC.
	Capacity building interventions	Postintervention perceived learnings from the capacity building interventions.
	Sustainable learning interventions	Postintervention perceived learnings from the sustainable learning interventions.
Teamwork and communication		Postintervention team relationships, mutual support between team members and extent of open communication.
	Provider buy-in	Postintervention involvement and participation of providers in the SS2020 intervention.
	Hierarchy and open communication	Postintervention extent of imbibed hierarchies including perceived comfort of junior team members in expressing opinions to seniors.
	Collective responsibility	Extent of collective ownership of SS2020, including sharing of responsibilities with non-surgeon providers in surgical teams.
Collective learning		Postintervention group learning, including the balance of individual learning aspirations against team learning goals, translation of knowledge to colleagues, use of data as a learning tool, extent of learning together as teams and evaluation.
	Knowledge translation	Postintervention sharing of knowledge by SS2020 training attendees with colleagues who did not attend trainings and new recruits.
	Data and monitoring	Postintervention perceived need for and nature of use of data for learning, monitoring and decision-making.
	Team learning	Postintervention extent of mutual support and collaboration in intervention tasks to achieve common goals.
Role of leadership		Postintervention leadership engagement with SS2020 and staff expectations about leadership support for intervention functions.
	Expectations from leadership	Postintervention staff expectations about leader's involvement.
	Leadership engagement	Postintervention leader's engagement with SS2020.
Perceived impact and beyond SS2020		Postintervention perceived impact of SS2020 and suggestions for improvement.

SS2020, Safe Surgery 2020; SSC, Surgical Safety Checklist.

to implement. The SSC made it easier to coordinate. (Anaesthetist, Facility 2)

Lower performer

Everyone is focused on their jobs. If I am busy, the nurse or surgeon can see that the BP is low. But they say this is the anaesthetist's job. If patients suffer, they will blame me. But they were in the room and did not say anything. If key staff do their jobs well, SSC can be implemented to help patients. (Anaesthetist, Facility 8)

Learning orientation

Higher performers were agile in experimenting with learning methods and adapting them. When one facility realised that SSC forms were being retrospectively filled to meet targets, they swiftly introduced direct observation to situate SSC as an 'active tool'. They had clear targets and assessed progress pragmatically, identifying gaps such as lapsed SSC utilisation during emergency procedures. In lower-performing facilities, at an individual level, providers were enthusiastic about learning skills like suturing techniques and spinal anaesthesia methods. Organisational learning seemed less purposeful, with less specific targets, and still developing monitoring strategies. Providers in two facilities claimed overwhelming success at midline with '100% SSC usage'. While lower performers did not experiment with the SS2020 toolkit, they were very focused on implementing practice changes as per SS2020 instructions.

Engagement with SS2020 intervention

Leadership and SSC training

In higher-performing facilities, the SSC was described as a tool to strengthen teamwork and communication. One provider said the SSC identified gaps in individual performance for the benefit of teams. Lower-performing facilities also implemented the SSC enthusiastically, but for clinical goals such as infection control and instrument counts after surgery. In one lower-performing facility, the SSC's clinical improvements were praised for their 'immediacy, clarity and visibility'. Thus, while SSC implementation was prioritised, it was aimed at clinical rather than cultural overhaul. This changed at endline in two lower-performing facilities. One surgeon underlined that SSC could encourage 'smooth and open communication'.

Higher performer

The SSC is about communication and learning together while doing. We don't have to hide mistakes to be graded as good providers. If you expose your mistake, you can be corrected. And ultimately the team benefits by learning from your mistake. (Surgical Provider, Facility 3)

Lower performer

Everything in the SSC is about improving surgical outcomes so we are spending much energy on SSC. Communication is fine, but if I use the form, I am forced to check everything. We will never leave a gauze behind again. (Surgical Provider, Facility 10)

Capacity building interventions

Both higher and lower performers undertook similar practice changes such as optimised antibiotic use and improved sterilisation practices. Higher performers described these as parallel to strengthening teamwork and communication, and implemented these changes sooner, so that by midline, improving data quality and monitoring were prioritised more. Providers in lower-performing facilities appreciated how these trainings augmented their skills and enhanced clinical practice. One anaesthetist underlined the 'transformative' changes such as reduced costs from optimal antibiotic use and improved care from distinguishing SSIs from sepsis.

Sustained learning interventions

Higher performers perceived these trainings as opportunities for continued advancement. In two lower-performing facilities, three providers appreciated the practical learnings of Project ECHO. However, as facilities, they seemed less engaged with these interventions, possibly since they were still focused on goals from earlier trainings. Inperson mentorship was an important exception in all three facilities. A surgeon in a lower-performing facility said a mentor's visit would serve as a reminder to "ensure we practice more, because we will be watched."

Teamwork and communication

Provider buy-in

Higher performers identified and tackled resistance to SS2020 early on, particularly from staff who did not attend SS2020 trainings. Two facilities prioritised periodical team check-ins and participative problem-solving. An anaesthetist described how senior staff strategically assigned key roles like supervising completion of SSC forms to dissenters to encourage them to 'take ownership'. In lower-performing facilities, while some providers were very motivated to implement changes, some who did not attend SS2020 trainings were less enthusiastic. Mechanisms to manage dissent emerged at endline, with providers in two facilities suggesting authoritarian approaches like making the SSC compulsory and penalising errant staff. While generally aware of shortcomings, nurses in two facilities said they could only follow instructions of senior staff. At endline, surgeons in two facilities called for more buy-in from nurses.

Hierarchy and open communication

In higher-performing facilities, non-surgical providers communicated freely. In two facilities, they felt their opinion was respected by seniors. A nurse took pride in how surgeons trusted her with managing the SSC. In lower-performing facilities, non-surgical providers expressed fear of rebuke in 'talking up' to seniors. They were referred to as 'subordinates' and 'low-cadre'. Importantly, a surgical team leader from a higher-performing facility also referred to colleagues as 'subordinates'. At endline, surgeons in two lower-performing facilities identified hierarchy as a barrier to clinical goals and encouraged nurses to communicate with them by name, ask questions and identify gaps in SSC use.

Higher performer

> Since I am controlling the checklist, I say attention please and read the points. Then all staff answer according to the questions asked. The doctor waits for me because he trusts that I will remind him if he has forgotten something. There is trust. (Anaesthetist, Facility 1)

Lower performer

> The surgeon was looking for the defective part, which looked like the patient's intestine. I told him what he was trying to remove was actually part of the intestine. The surgeon asked if I had more knowledge than him. He said as a surgeon he knew the difference. After opening, he realized he had cut the intestine. (Nurse, Facility 9)

Collective responsibility

In higher-performing facilities, non-surgeon providers were entrusted with more SS2020 responsibilities, which motivated them to take ownership. In all facilities, nurses managed postdischarge care. Anaesthetists taking special interest in SSC were designated 'champions' and became its informal drivers in three facilities. In all lower-performing facilities, surgeons were perceived as responsible for SS2020. Other providers, while appreciative of SS2020 practice changes, identified their roles as ancillary. They also tended to hold surgeons responsible for lapses. An anaesthetist in one facility who oversaw SSC utilisation was an important exception. At endline, recognising their fatigue was hindering SSC utilisation, senior staff in two facilities encouraged more involvement from other providers.

Collective learning

Knowledge translation

Higher performers emphasised knowledge transfer from providers who attended SS2020 trainings. All facilities convened debriefing meetings within a week of trainings, with biweekly or monthly follow-up, and focused agenda items, such as distinguishing SSIs from sepsis and completion of SSC forms. In one facility, an anaesthetist described efforts to break SS2020 lessons in 'bite size pieces' and ongoing conversations with reticent colleagues. Lower-performing facilities also convened knowledge translation meetings, but around 3 weeks post-training. Providers felt their time was better used in implementing changes than convincing reticent colleagues and requested SS2020 trainings for all staff in early stages. A surgeon suggested SS2020 could be expedited if responsibilities were restricted to trainees. At endline, there was a gap between training attendees and non-attendees.

Higher performer

> Those of us that went for leadership training found time to teach others within a week. People argued that they knew their jobs, or that it would be impossible to complete the SSC while operating. But what we did, and it is a continuing process, was to sit down and repeatedly explain research on surgical errors, and the importance of each step in the SSC. (Surgical Provider, Facility 2)

Lower performer

> Staff who attended leadership and clinical training are champions of SS2020. But others feel it is a waste of time. And unless there is pressure from above, why should they listen to us? (Surgical Provider, Facility 8)

Data and monitoring

Providers in three higher-performing facilities discussed how SS2020 sensitised them to leveraging data for improving surgical quality. By midline, one facility triangulated preoperative, operative and post-operative care data to 'catch our mistakes'. In another facility, a provider said data made providers *feel* responsible for every postsurgical infection. Providers in two lower-performing facilities articulated the need to improve monitoring of clinical outcomes at endline. Importantly, one facility leader appreciated the importance of data earlier at midline, but said his team needed more time. At endline, providers across lower-performing facilities sought more training to effectively use data.

Team learning

Surgical teams in higher-performing facilities came together to learn as collective units, identifying strategies such as role designation and rotation of responsibilities, to ensure 'no one was left behind'. In lower-performing facilities, while improving patient care was described as the end goal in two facilities, learning was focused on improving individual skills. In the third facility, a provider described team improvement as the aggregate of individual providers' improvement. Importantly, teams began to emerge as units of learning at endline in two facilities, with the recognition of the importance of teamwork, open communication and

sharing of responsibilities with junior providers as necessary for improving patient outcomes.

Role of leadership

Expectations from leadership

Staff in two higher-performing facilities sought active everyday leadership involvement such as managing resistance. In all lower-performing facilities, while facility leaders were described as committed to SS2020, they were perceived as too occupied for routine involvement. In two facilities, leaders were appreciated for administrative requirements like SSC forms and supporting infrastructural improvements.

Leadership engagement

In higher-performing facilities, leaders were aware of their facility's progress. In two facilities, leaders and surgical team leaders selected resistors as training attendees to motivate them. Leaders also prioritised training of new hires. Leaders in lower-performing facilities helmed larger facilities. While they were very supportive of SS2020, with limited time they performed supervisory roles, managed purchases and renovations. In two facilities, leaders said they communicated with surgical team leaders, who were driving SS2020, and intervened when asked.

Higher performer

> I monitor daily reports. Every morning we have reports from each department, they tell us how many surgeries they have done and how. I also speak with dissenters. There is a very stubborn nurse who does not like the SS2020 changes. So, I insisted that she attend the training. Special effort is needed for those who are disturbing others. (Medical Officer-in-Charge, Facility 2)

Lower performer

> I am too busy to check if one-third files aren't available or one-third aren't documented. I ask them to come to me with specific problems. They were having problems with purchasing antibiotics since our routine antibiotics were not ascribed by SS2020. So as management I intervened. (Medical Officer-in-Charge, Facility 10)

Perceived impact of SS2020 and beyond

Providers in higher-performing facilities appreciated how SS2020 helped overhaul surgical ecosystems by strengthening team relationships, promoting data-driven decisions and improving surgical outcomes. In lower-performing facilities, providers praised SS2020 for improvements in infrastructure and gains in provider knowledge and skills. Suggestions for improving SS2020 interventions from higher-performing facilities included translating the SSC to Swahili and a shorter version for emergency surgeries. In lower-performing facilities, providers suggested SS2020 trainings for all staff and inperson mentorship.

Higher performer

> Everyone is a watchdog and mentor to each other. Our golden strategy was focusing on everyone, the head of the OR, the anaesthetist and the nurses. If I am not following the SSC, someone will always remind me. We previously collected data to send to the government, but now we know it belongs to us, to help us know where we are and where we want to go. (Surgical Provider, Facility 1)

Lower performer

> We have made good progress in infrastructure with modern equipment and renovation of ORs. Doctors and nurses have been trained in sterilization and better surgical skills. Now we need more trainings or mentorship. If you know that next month a mentor will come, it makes you practice more and achieve more. (Anaesthetist, Facility 9)

Conceptual framework

A facility's preintervention context, including its physical, cultural and learning characteristics, set the foundation for its engagement with SS2020 and subsequent advancement in organisational culture and organisational learning (figure 2). Lower performers showed substantial improvement in surgical safety practices (table 2). Differences in performance trajectories of higher and lower performers were relative. For all facilities, immediate changes in safety practices were interlinked with cultural changes in teamwork and communication, which in turn helped create structures and processes for sustainability of changes. Higher performers targeted surgical ecosystems holistically on team communication and organisational learning. Lower performers prioritised improving surgical safety practices in the short term. At endline, they had just begun initiating change on non-clinical aspects. While showing definite improvement in surgical practices, lower performers trailed higher performers on culture and learning on the change continuum.

DISCUSSION

We identified factors distinguishing higher-performing and lower-performing facilities in an intervention to improve surgical quality in Tanzania, filling a critical knowledge gap about drivers of variation in outcomes across facilities.[2 6 8] The terms 'lower' and 'higher' performance refer to relative performance outcomes within the context of our study design. In actuality, lower performers achieved substantial improvements in their surgical safety practices.

While our analytic approach deliberately focused on deviance, there were common themes among higher and lower performers. Both valued improving knowledge and surgical practices through the SSC, capacity

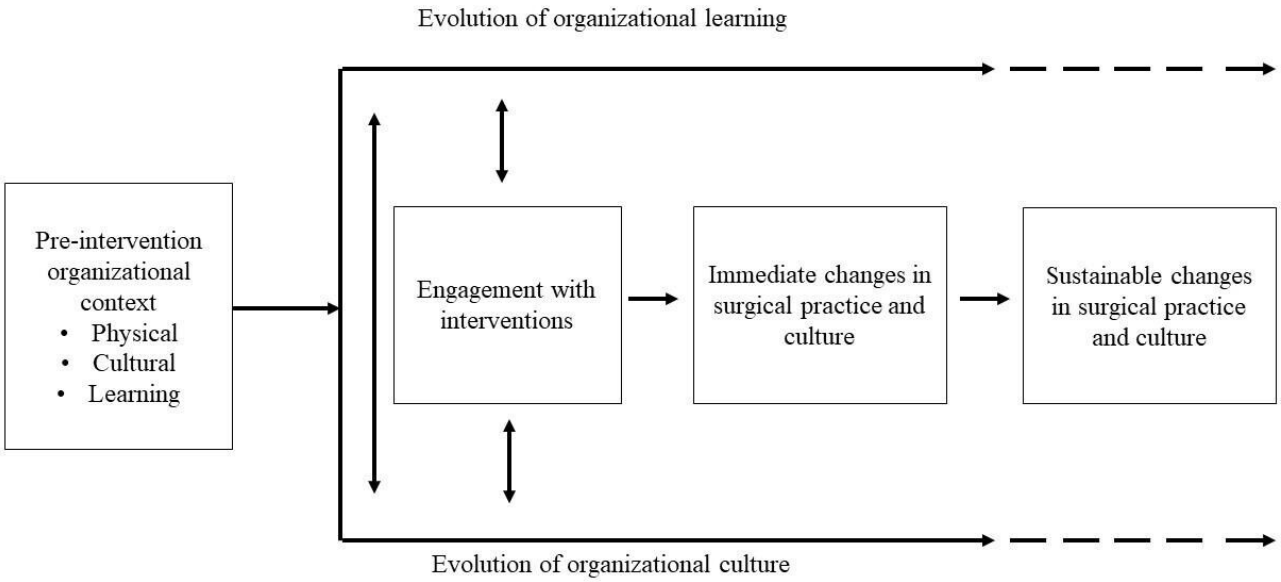

Figure 2 Framework and theory of change.

building interventions and inperson mentorship. Lower performers also recognised the importance of data monitoring, teamwork and open communication towards endline. Our findings provide important lessons for policymakers, funders and practitioners interested in scaling surgical quality.

Non-technical aspects of surgery may be central to performance. While efforts to improve surgical quality often focus on clinical interventions, we found focus on teamwork and collective learning differentiated higher-performing and lower-performing facilities. Our findings echo those of Bradley *et al*,[6] who found non-clinical skills differentiated higher performers in an intervention to improve primary care quality and access in Ethiopia. A growing number of studies in surgery have also found performance is influenced by teamwork and collective learning capabilities.[49–54] While non-technical skills required for surgical providers in LMICs are not different from those required in HICs, providers in LMICs must address constraints related to insufficient personnel, equipment or supplies.[55] The Non-Technical Skills for Surgeons behavioural assessment tool can be used to develop teamwork training tailored to the LMIC context.[56–58] Strategies such as using data for improvement, creating spaces for reflection and a culture of psychological safety can foster collective learning.[50 59 60]

Furthermore, tailoring interventions to meet the needs of individual facilities may be beneficial. Higher performers in our study were smaller-sized facilities. This finding is consistent with a US study which found small facility size was associated with a fourfold increase in the odds of reporting successful implementation of a surgical checklist.[61] The literature suggests possible reasons. All surgical team members were able to participate in trainings, which possibly facilitated greater buy-in and lower resistance to change.[62] Training the team as a whole may also have contributed to improved outcomes.[63 64] Implementation may also have been aided by better communication, flexibility and fewer people to bring on board with changes in smaller facilities.[61 65] Since facilities had different starting points in their physical and cultural contexts, a 'one-size fits all' approach to interventions may not be optimal. Future safe surgery initiatives should consider preintervention assessments of organisational culture and readiness to tailor interventions for each facility.[66–70] For example, lower-performing facilities may benefit from training all surgical team members rather than a few staff, focusing on clinical interventions before emphasising cultural change, leadership engagement and tailored coaching by mentors.

Implementation has been suggested as the 'critical gateway' between adoption and routine use of an innovation, and therefore requires attention.[71 72] We found that leaders in higher-performing facilities were more engaged in the implementation of SS2020. Engaged leaders understand the requisites for successful implementation of interventions, can frame implementation for learning and address provider resistance.[49–51 73–75] Future trainings for leadership and data quality should include facility leaders and regional health management teams. Lower-performing facilities in our study struggled with engaging dissenters. As experience in HICs has shown, raising awareness about safe surgery among stakeholders, internal training, adapting interventions to local context and learning collectively from performance monitoring can foster a receptive implementation climate.[24 61] Finally, the context for implementation in LMICs requires focusing on the whole surgical system, including strengthening infrastructure, changing culture, building capacity of surgical teams and senior leadership support.[34 64 76 77]

Our findings have important limitations. First, our sample size was small. Additional investigation in diverse contexts is necessary for generalisability. Importantly, higher and lower performers could have been different in ways not captured in our themes. Our measurement of higher-performing and lower-performing facilities was limited to one composite measure of 14 indicators on the SSC. Measures outside the operating room on surgical outcomes as well as cultural and learning aspects would have strengthened it. We also treated all improvements (eg, 25%–45% vs 75%–95%) to be of similar significance even though greater adherence to the SSC might lead to better outcomes.[77 78] We could not pilot-test our interview guide due to time constraints, but we did not encounter problems with interpretation of questions. Interviewee responses may be subject to recall and social desirability biases. The majority of the interviewees attended SS2020 trainings so we do not know enough about the perspectives of those not trained. Finally, further quantitative research in larger samples is required to assess whether our findings apply in different contexts.

CONCLUSION

While interventions to improve surgical quality are growing, knowledge on how best to improve surgical quality in LMICs is scant. Our results suggest that investing in non-technical skills including teamwork and communication and collective learning may be critical to improving surgical quality. Building these capabilities in surgical teams, tailoring interventions to facility context through preintervention assessments and strong leadership engagement to build a receptive climate can facilitate successful implementation of safe surgery interventions.

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the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

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