Improving Rates of Delayed Cord Clamping in Ethiopian Hospitals: A Virtual Quality Collaborative

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abstract

OBJECTIVE: Although curricula to teach quality improvement (QI) methodology exist for global settings, ongoing mentorship and support to implement QI practices have not been well established. Leveraging the ECHO methodology, we taught a basic QI curriculum and established a learning community to improve a chosen gap in essential newborn care, delayed cord clamping (DCC).

METHODS: The Ethiopian Neonatal Quality Improvement (EN-QI) Project was conducted from February 2021 to January 2022 across 8 delivery centers selected by the Ethiopian Pediatrics Society. Each site set a SMART (Specific-Measurable-Attainable-Relevant-Time bound) aim for improvement in DCC. Virtual QI training sessions were held monthly, and site-specific progress was tracked. The primary outcome was the percentage of deliveries at each site that achieved DCC. The process measure was defined as setting an institutional SMART aim, which all sites were able to complete. Each site represented their progress via DCC% line graphs. Post hoc balancing measures included time to first breath and time to skin-to-skin. Outcome measures were analyzed using control charts, with a post hoc analysis assessing average time to cord clamping across all sites.

RESULTS: SMART aim targets ranged from 50% to 90% DCC across sites. Initial rates ranged from 7% to 72%, with 6 of the 8 sites having initial DCC rates at or below 50%. Six months into the project, 7 of the 8 sites had DCC rates above 50%. A combined analysis of all sites included over 3500 observed deliveries and an end-of-project DCC rate above 90%.

CONCLUSIONS: Implementation of a remote, virtual peer-led, QI initiative increased the rate of DCC at the 8 participating sites in Addis Ababa. Local QI teams demonstrated the ability to adopt and sustain DCC within their delivery room settings. EN-QI may serve as a model for other QI initiatives in low-resource settings.

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INTRODUCTION

Global neonatal mortality and morbidity remain unacceptably high in low-and-middle-income countries (LMICs).[1] The Helping Babies Breathe (HBB) curriculum contains evidence-based life-sustaining interventions and simulation-based training designed to equip health care workers in LMICs to prevent leading causes of neonatal morbidity and mortality.[2,3] HBB training recommends delayed cord clamping (DCC) for 1 to 3 minutes after birth. Systematic reviews of this practice

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have shown a reduction in mortality for preterm infants with the Cochrane Neonatal review concluding that "Early cord clamping probably causes harm."[4] Both term and preterm infants receive an increased blood volume through DCC, which can lead to an improvement in cardiovascular stability and faster transition to extrauterine life.[5]

In 2014, the World Health Organization (WHO) released a set of Newborn Quality Indicators aimed at improving the quality of care in health facilities, one of which is DCC, concluding that "Delayed umbilical cord clamping (not earlier than 1 min after birth) is recommended for improved maternal and infant health and nutrition outcomes."[6] The practice of DCC can provide a low-cost, effective means of improved neonatal outcomes and the avoidance of iron deficiency anemia and the resulting neurodevelopmental consequences seen in childhood.[7]

Despite these recommendations, uptake of DCC and other evidence-based practices into clinical care has been variable in both high-income countries and in LMICs.[8] A variety of strategies may improve the incorporation of these practices into clinical care (eg, educational programs). One strategy that is particularly effective is the use of quality improvement (QI) methodology.[9,10] QI initiatives typically include data collection that facilitates benchmarking and comparison of processes and outcomes of care within and between institutions, immediate access to data for review, and multidisciplinary team participation.[11]

Our project aim was to examine the impact of a peer-led, perinatal QI training program in a multisite collaborative in an LMIC setting. Specifically, we planned to test an implementation strategy using a virtual, internet-based platform. A learning community was formed by neonatal global health members of the American Academy of Pediatrics (AAP) and the Ethiopian Pediatrics Society (EPS) using the virtual platform Project ECHO (Extension for Community Healthcare Outcomes).

METHODS

Context

This regional intervention was carried out in 8 health facilities with delivery services in the Ethiopian Neonatal Network (ENN) in Addis Ababa, Ethiopia. The ENN was established in 2018 by the Vermont Oxford Network in collaboration with the Ministry of Health and the EPS. It currently comprises 22 inpatient neonatal units caring for small and sick newborns. Among hospitals in the ENN, 8 were chosen by the EPS for this project because they are part of the Addis Ababa City Administrative Health Bureau, which limited travel and administrative burdens (eg, health authority approvals) for this project. Each project site was in a government-funded, urban facility located in Addis Ababa. Births were attended by nurse midwives and obstetricians who were available to attend difficult deliveries to perform cesarean sections when indicated (Table 1).

Key Partners

The AAP Global Child Health and Life Support Division provided leadership and core funding. The AAP Section on Neonatal-Perinatal Medicine (SoNPM) Global Health

TABLE 1. Hospital Sites With Respective Deliveries Observed and SMART Aim Achievements

Hospital Sites and Selected SMART Aims					
Hospital	No. of Deliveries[a]	No. of Cases Observed	SMART Aim	% of Cases With Delayed Cord Clamping Achieved by Project End	Achieved Site Specific SMART Aim?
Site 1	6721	688	To increase the percentage of delayed cord clamping from 36% to 90% by July 31, 2021	87%	No
Site 2	9453	221	To increase the percentage of delayed cord clamping from 14% to 90% by August 31, 2021	76%	No
Site 3	4326	274	To increase the percentage of delayed cord clamping from 7% to 50% by June 31, 2021	53%	Yes
Site 4	9220	577	To increase the percentage of delayed cord clamping from 50% to 80% by July 31, 2021	75%	No
Site 5	5000	288	To increase the percentage of delayed cord clamping from 10% to 60% by July 31, 2021	72%	Yes
Site 6	7500	648	To increase the percentage of delayed cord clamping from 52% to 80% by July 31, 2021	92%	Yes
Site 7	9555	372	To increase the percentage of delayed cord clamping from 30% to 90% by July 31, 2021	79%	No
Site 8	5016	453	To increase the percentage of delayed cord clamping from 72% to 90% by July 31, 2021	91%	Yes

Abbreviation: SMART, Specific-Measurable-Attainable-Relevant-Time bound.
[a] Delivery number is estimated from data for calendar year 2021.
Criteria for achievement of the SMART aim is displayed by number of cases and % of delayed cord clamping.

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Committee organized the initiative in collaboration with the EPS. The EPS coordinated all in-country activities. A US-based technical advisory team composed of a neonatologist with experience working in global health partnerships and a neonatology fellow-in-training was assigned to each hospital. The faculty and fellows were recruited by the SoNPM Global Health Committee from academic institutions across the United States. Laerdal Global Health helped develop the data collection tool, received virtual data from each site, and returned collated data to the EPS. Local participants included all delivery room and newborn care clinicians and their supervisory personnel (see Figure 1 for organizational structure).

Virtual Platform

Project ECHO was the virtual platform for this quality initiative. Project ECHO is a telementoring program housed at the University of New Mexico Health Sciences Center. It creates communities of learners across geographic locations by bringing together health care practitioners and experts or technical advisors, using a hybrid model of didactics and practitioner-led presentations. This is designed as a bidirectional virtual network that enables both the exchange of knowledge from clinical experts and the presentation of clinical challenges and insights from the site lead, who serves as the local QI coach. The AAP, as the only existing pediatric superhub for the Project ECHO Platform, had its designated Project ECHO team provide the necessary training and equipment to establish a hub in the offices of the EPS and provided necessary hardware to participant hospitals. The AAP provided EPS with funding to purchase a tablet for each participant facility and hot spots to facilitate Wi-Fi connection.

Planning the Intervention

Prior to beginning the project, a memorandum of agreement was established between the EPS and each participant hospital in collaboration with local administrative and clinical leaders. A midwife or nursing leader was identified at each site to serve as the site's QI coach for this project. Digital devices were distributed to the EPS and participant hospitals, and the availability of internet connectivity for the hospital-based coaches was established (ie, data plan support for cell service).

Intervention

The EN-QI project began in January of 2021 with a virtual teleconference attended by representatives from the EPS hub and the 8 participant hospitals, selected leaders from the AAP leadership, members of the SoNPM Global Health Committee, and the technical advisory teams. The purpose of the teleconference was to orient participant hospitals to the program structure, plan, and methodology, and to initiate critical first steps in beginning a QI project. This included (1) an overview of the QI learning program plan, (2) a review of principles of QI, and (3) establishment of methods to identify gaps. The following week, each coach

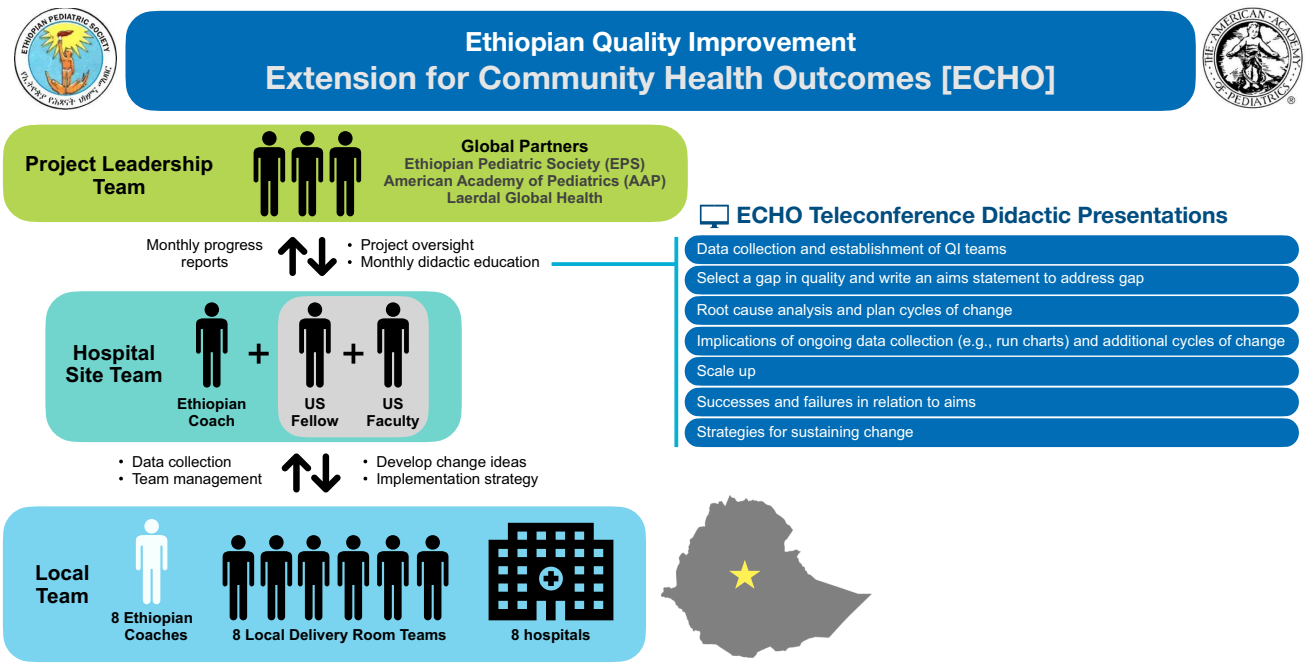

FIGURE 1.
Schematic of the EPS/AAP virtual partnership.

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participated in a 2-day virtual training program led by the EPS and the AAP advisors.

The initial teleconference was followed by monthly teleconferences for a total project period of 12 months. The purpose of these teleconferences was to provide QI education, support, and supervision of the hospital-based coaches as they led local initiatives. In addition to the coaches, participants included project leaders from the EPS and AAP SoNPM Global Health Committee and the US-based technical advisory dyads assigned to each institution. Facilitation of the monthly teleconferences rotated among EPS leadership, AAP advisors, and site QI coaches and were conducted in a hybrid of English and Amharic to facilitate local engagement. During the first 6 teleconferences, the content of the workbook *Improving Care of Mothers and Babies* in Amharic, the primary language spoken in the region, was reviewed with the hospital-based coaches; see Table 2 for content.[12] During subsequent teleconferences, data, interventions, and progress toward achieving aims were reviewed. A critical resource for guiding the discussion of progress was the local DCC% line graphs for the primary outcome for each hospital (see "Analysis").

The agreed upon area of improvement was timing of cord clamping as there was consensus among practitioners that DCC was not routinely practiced and improvement in this practice would be achievable and practical. Each site developed a unique SMART aim for facility-level improvement in DCC. No single overarching SMART aim was developed. During the monthly teleconferences, site-specific progress was presented and discussed, with an open forum to provide feedback and suggestions regarding each QI initiative. Site-specific results for each of the participating delivery hospitals displayed as DCC% line graphs (see "Analysis") were shared with the entire group during the monthly meeting sessions. These were often the focal point of group discussions. The Project ECHO platform enabled each site to share their unique experience in actuating a QI intervention. In addition, technical advisory teams conducted independent virtual interactions with their assigned local hospital coach, primarily via email and WhatsApp.

Measures

The primary outcome was the percentage of deliveries at each site that achieved DCC, defined as cord clamping for at least 60 seconds after birth. The process measure was defined as setting an institutional SMART aim, which all sites were able to complete. Following completion of the project, time to first breath and time to skin-to-skin were examined as balancing measures to evaluate whether institution of DCC delayed time to first breath or time to skin-to-skin.

Data Collection

Using a mobile application called Liveborn (codeveloped by Laerdal Global Health and the University of North Carolina at Chapel Hill), hospital-based QI coaches, or a designee, documented the start and stop time of resuscitative practices (drying/stimulation, suction, bag-and-mask ventilation), time to first breath, time to skin-to-skin, and the time of cord clamping.[13] Data were collected by direct

TABLE 2. Summary of the 6 Steps With Corresponding Objectives Outlined in the Improving Care of Mothers and Babies Workbook

Improving Care of Mothers and Babies – 6 Steps in Quality Improvement[12]	
Steps	**Objectives**
Step 1: Create an improvement team	• Understand the advantages of working in a team to improve care • Create an improvement team
Step 2: Decide what to improve	• Understand where gaps in quality can occur • Identify gaps in quality • Choose what to improve • Perform a baseline assessment • Write an aim statement
Step 3: Choose the barriers to overcome	• Understand common reasons for gaps in quality of care • Identify barriers to the process or outcome chosen for improvement • Select the barriers to overcome
Step 4: Plan and test change	• Identify and select changes that may improve care • Develop a plan for change • Test the changes in the plan
Step 5: Determine if the change resulted in improvement	• Determine if the actions in the change have occurred • Determine if the change produced improvement • Decide on next steps • Start the next cycle of improvement
Step 6: Make improvement the norm	• Communicate changes that resulted in improvement • Facilitate practice of changes • Overcome objections to change • Make an improvement a permanent part of a facility's routine

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observation by the QI coach. Therefore, data were only available for deliveries at which the QI coach was present and available to observe (ie, not directly involved in patient care). Data from the Liveborn application were then uploaded via the internet to Laerdal Global Health. De-identified data were then downloaded into Microsoft Excel spreadsheets and maintained by the EPS. The EPS was responsible for the management of all-hospital datasets. They were also responsible for creating user-friendly collated data in the form of line graphs for use by each hospital. Line graphs depicted the percentage of deliveries for which DCC occurred during each month of the study period. Also, a line graph was used to depict aggregate data for all sites. Line graphs were used by sites to evaluate progress toward achieving their SMART aims.

Analysis

Using the line graphs, we examined the primary outcome every month for each participating hospital. We used a line graph of percentage of observed deliveries in which DCC occurred to monitor progress across participant hospitals. In addition, we used aggregate data in an X-bar R chart to evaluate the change in average time to cord clamping during of the project period. Each point on the chart represented the mean for 20 consecutive observations ordered by time of birth, independent of location. Given that there were time-based variations in data observations, clustering the observations into consecutive cases allowed for adequate power and clarity in project progress along the x-axis. Post hoc balancing measures were analyzed in a similar fashion using an X-bar R chart to evaluate change in average time to first breath and time to skin-to-skin. Aggregate data were analyzed utilizing QI Macros version 2023 (KnowWare International Inc.) to determine when special cause variation occurred. We used standard health care rules to identify special cause variation.[14]

Ethical Considerations

On advice from AAP and EPS leadership, this study obtained approval through the AAP Institutional Review Board (IRB). Approval included a waiver of consent, as this project was not judged to be human subject research. The EPS does not have an IRB; however, each participating hospital signed an agreement to take part in this QI project as members of ENN.

RESULTS

During the study period, over 56 000 deliveries occurred in project hospitals. Observation and recording of data occurred during 3521 deliveries (6.2%). The percentage of observed deliveries among sites ranged from 2.3% to 10.2%.

SMART aim targets ranged from 50% to 90% DCC across sites (Table 1). Rates of DCC at the initiation of the project ranged from 7% to 72%, with 6 of the 8 sites having initial DCC rates at or below 50% (Figure 2). During the last month of the project, rates ranged from 53% to 92%; all sites had rates above 50%, and 6 sites had rates of 75% or greater. Half of the sites had rates of DCC in the last month of the project that reached or exceeded the goal set in their SMART aim. There was progression in average rates of DCC across all sites, from 28% at initiation of the project to greater than 90% in the last 4 months (Figure 3). The X-bar R chart that included aggregated data from all sites demonstrated an increase in the average time to cord clamping from 43.8 seconds to 91.0 seconds (Figure 4). The chart did reveal special cause signals. In contrast, post hoc analysis of the balancing measures using X-bar R charts demonstrated that time to first breath remained stable at 6.9 seconds, and time to skin-to-skin remained stable at 23.1 seconds.

DISCUSSION

In this multicenter QI initiative, the EN-QI Project ECHO, we used a virtual platform to assist 8 hospitals in Ethiopia in the use of QI methodology to incorporate an evidence-based practice, DCC, into their care. All sites had higher rates of DCC during the last month of the project compared with the first month, and half of the sites achieved their SMART aim set at the beginning of the project. One of the key components of this initiative was strengthening the capacity of the health care workforce at the local level through educational training in QI methods. The Project ECHO–based bidirectional training program afforded both the local QI coaches and the remote technical advisors the opportunity to learn from each other and apply the fundamental methods of QI within a low-resource and local context.

The use of a platform such as Project ECHO may represent a low-cost, time-efficient method to disseminate QI methodology and tools that can be applied to other aspects of neonatal global health. The AAP is currently leveraging the Project ECHO methodology to disseminate the new WHO *Essential Newborn Care* course,[15] which utilizes the HBB learning methodology following training with ongoing coaching and mentorship around QI and health systems strengthening. Neonatal global health QI experts can be paired with practitioners in LMICs to help them develop sustainable and impactful projects for their setting. This may ultimately lead to a reduction in neonatal mortality and the national achievement of the United Nations Sustainable Development Goal 3.2.[16]

We believe that critical features of this project were active administration and oversight by a local organization, the EPS, and local leadership at the implementing sites by the hospital-based coaches. Having the active support of local leadership played a key role maintaining active engagement in the project. Engaging care practitioners and sustaining QI efforts was facilitated by a local

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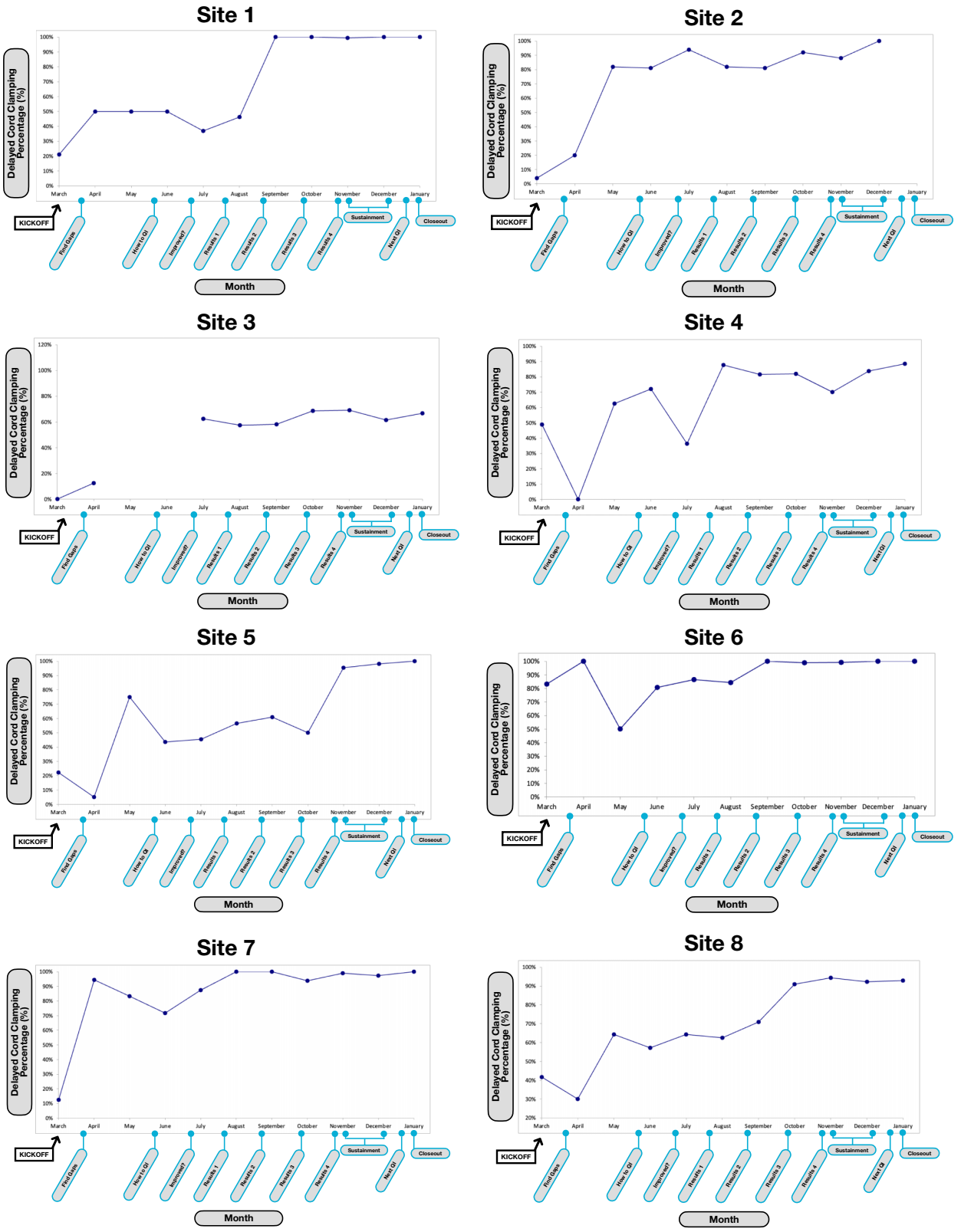

FIGURE 2.
Site-specific line graphs demonstrating the individual outcome measures for rate (%) of delayed cord clamping.

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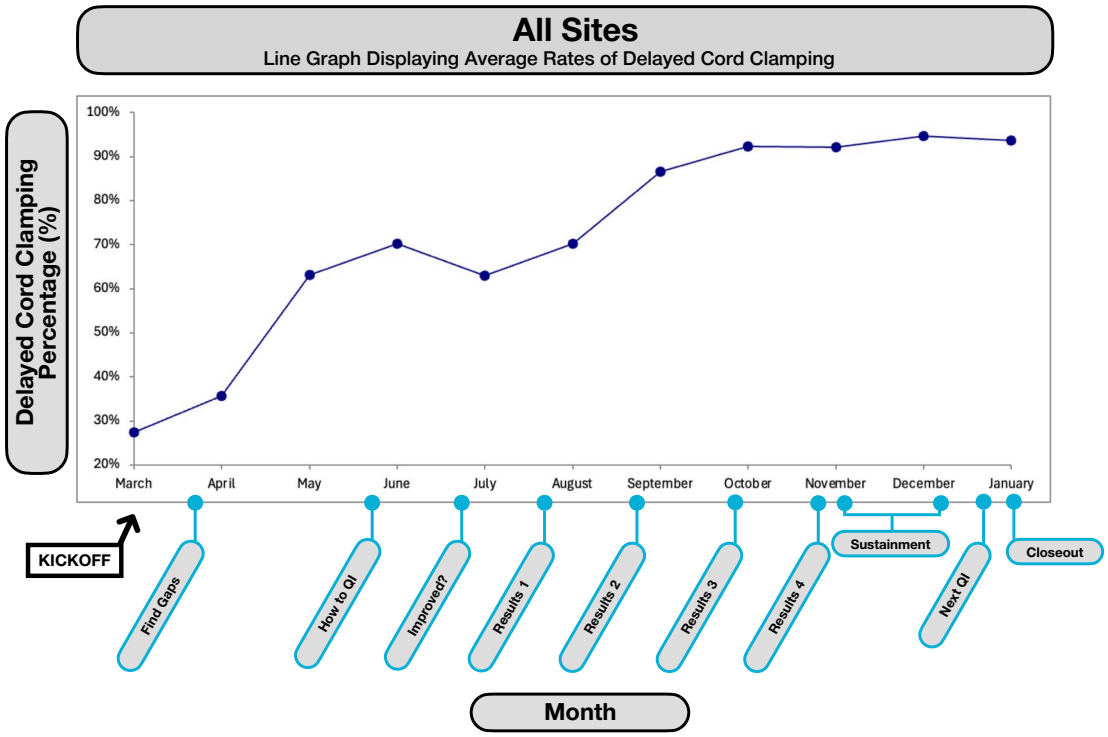

FIGURE 3.
Line graph demonstrating the aggregate primary outcome measure for rate (%) of delayed cord clamping across the 8 participating sites.

champion. EPS leadership identified motivated delivery attendants at each site to serve as these champions in their role as QI coaches. This captured the participant-driven aspects of QI by encouraging local leadership in the design phase of the project. Each leader was able to develop their own SMART aim based on their own assessment of baseline data collected and what they perceived to be an achievable goal at their respective institutions. Additionally, each QI coach was also responsible for the implementation strategy and local education of their QI team to carry out the project. In some sites, the QI coach was the sole person entering the data, which led to some sporadic data collection. Other sites trained additional staff in data entry, which facilitated more consistent data collection.

Inherent to the nature of QI, our project encountered challenges and limitations. A significant challenge relates to the virtual nature of this global initiative. Most of the technical advisors had never been to Ethiopia and lacked both firsthand contextual knowledge of the health care setting and a preexisting relationship with the local QI coaches. Given that the project was conducted virtually, its success also relied on the ability of the remote technical advisors to facilitate problem-solving by the local health care professionals. Regular attendance at each of the monthly meetings was also difficult. Logistical challenges included variability in internet connectivity working across several time zones and availability of both the local QI coaches and technical advisors to step away from their regular clinical activities to attend each session. Another limitation inherent to this project is the possibility of observer bias given that the data analyzed were obtained via direct observation by the QI coaches. Although direct observation of health care processes can offer opportunities to understand the potential barriers and facilitators to effective care delivery, we cannot account for the performance in deliveries that were not observed. One of the ways that data were efficiently collected was via the use of the Liveborn app, which is an additional tool that was not a part of the normal workflow for any of the participating sites. For 3 out of the 8 participating sites, there were periods during the project where there was a gap in data collection and reporting. This project was not designed to evaluate longer-term sustainability, a critical feature of enduring QI endeavors. However, as local QI capacity and capability grow, this platform could be used for ongoing monitoring. Also, additional outcomes, processes, and balancing measures could be collected, and real-time statistical process control analysis could be incorporated.

We used a strategy of data collection describing the timing of cord clamping for a convenience sample of deliveries, and the sample represented a small proportion of all deliveries. This strategy was chosen for pragmatic reasons. Continuous, comprehensive collection for all deliveries would have required resources, both human and financial,

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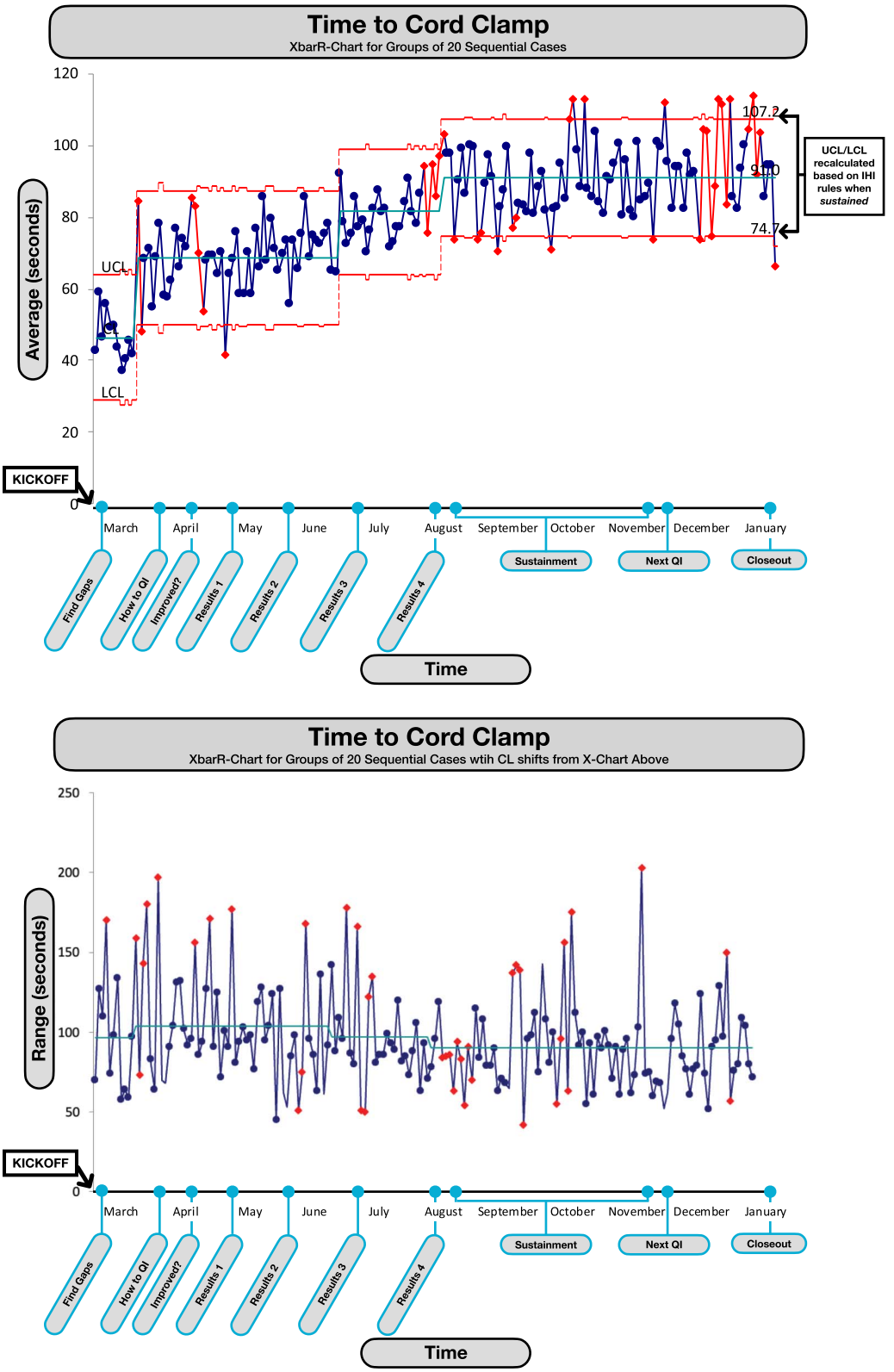

FIGURE 4.
X-bar R control chart with combined hospital site data for subgroups of 20 sequential cases, independent of location, displaying average time (seconds) to cord clamping. Each annotation represents the topic of the monthly teleconference, briefly defined here: (1) Kickoff/Find Gaps: Brief introductions of all members of team, along with a summary outlining the objective of the project. An introduction of how to identify gaps in care

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was also described, as defined in the HBS QI guide. (2) How to QI: An introduction into QI methodology, including a review on how to identify gaps in care delivery, the importance of data collection at each stage in the process, key stakeholders required to effect change, and determining areas of improvement in the care process. (3) Improved?: How to determine, through data collection and tracking via Line graphs, if there has been an improvement in the gap identified. (4) Results 1–4: In these teleconferences, sites were asked to assemble and present the following data: Project Overview, including restating the identified gap, process to address the gap, describing how they are trying to measure the problem, progress since the previous meeting, and present their plans for next steps for the next month. (5) Sustainment: Discussion surrounding goals and ideas to sustain efforts in DCC at the project close. (6) Next QI: Open discussion among the sites and EPS leadership regarding ideas for a second QI project. (7) Closeout: Review of the QI Collaborative, summarizing the success and challenges related to quality improvement.

beyond those available for this project. This limitation is a common problem of QI projects in LMICs. Periodic data collection is a reasonable approach for processes or outcomes if a sample is likely to be sufficiently representative and resources are limited. However, this approach may not be suitable for some processes or outcomes, particularly those that are infrequent (eg, mortality).

Additionally, the sites chosen were all government-run urban hospitals within Addis Ababa. The unique sites each represented a range of resources, which reflects potential for adaptability to other urban centers of varying levels. However, this may not be generalizable to other centers within Ethiopia or other LMICs. Use of this model within rural settings also needs to be explored.

CONCLUSION

In this multicenter QI initiative, we used a virtual platform to assist 8 hospitals in Ethiopia in use of QI methodology to incorporate an evidence-based practice, DCC, into their care. Administration of the project was the responsibility of a local organization, the EPS. A critical feature of the project was linking coaches at each hospital with a US advisory team consisting of neonatologists and a neonatal trainee. The hospital-based coaches directed QI teams and demonstrated the ability to improve the rate of DCC. A QI initiative to improve delayed umbilical cord clamping rates at 8 delivery centers in Addis Ababa, Ethiopia, significantly increased the rate of this clinical practice. The Project ECHO methodology proved to be a successful methodology to disseminate QI framework and tools for learners to demonstrate their newly acquired knowledge in QI to improve rates of DCC. This regional QI collaborative approach may serve as a model for other QI initiatives in low-resource settings.

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ABBREVIATIONS

AAP: American Academy of Pediatrics
AAP SoNPM GHSC: Section on Neonatal-Perinatal Medicine Global Health Subcommittee
DCC: delayed cord clamping
ECHO: Extension for Community Healthcare Outcomes
ENN: Ethiopian Neonatal Network
EN-QI: Ethiopian Neonatal Quality Improvement
EPS: Ethiopian Pediatrics Society
HBB: Helping Babies Breathe
LMICs: low- and middle-income countries
QI: quality improvement
SMART: Specific-Measurable-Attainable-Relevant-Time bound
WHO: World Health Organization

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