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Cesarean Delivery in Low- and Middle-Income Countries: A Review of Quality of Care Metrics and Targets for Improvement

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Abstract

Improving quality of care in low- and middle-income countries (LMICs) is a global priority, specifically around maternal and newborn care, where mortality and morbidity remain unacceptably high. Cesarean delivery is the most common procedure in women, thus evaluating quality around the provision of intervention provides insight into overall quality of care around childbirth. In this review we provide an overview on the quality of care around cesarean delivery using the six domains of quality proposed by the Institute of Medicine: *equity*, *effectiveness*, *efficiency*, *safety*, *timeliness* and *patient-centered care*. We review the evidence of quality gaps in each of these domains around cesarean delivery in LMICs, discuss opportunities for improvement and provide suggestions on metrics for tracking quality in each of these domains. As cesarean delivery rates increase globally, efforts to ensure quality will be essential to drive continued and sustained improvements in global maternal and newborn outcomes.

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Contribution of authorship

The idea of this review was conceived by AAB and KD. AAB drafted the review. AAB, JN, GG, BW, MM, and KD all contributed content and development of the article. All authors reviewed and agreed to the final version of this manuscript.

Declaration of interests

AAB provides consulting services to Microchips Biotech on contraceptive technology in low- and middle-income countries and is on the scientific advisory board for RHIA Ventures, a US based company investing in technology for reproductive health. There are no conflicts of interest with the work presented in this manuscript.

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No ethics approval required

Keywords

cesarean delivery; quality of care; low- and middle-income countries; childbirth; safety

Introduction

Global maternal and newborn mortality remains a significant public health challenge, particularly in sub-Saharan Africa and South-East Asia, which together account for 86% of the 295,000 maternal deaths in 2017, and 84% of the 2.5 million neonatal and stillbirths occurring globally each year [1,2]. Promoting access to skilled birth attendance and facility-based delivery has been a key strategy amongst maternal and child health global advocates. Yet, despite increases in both skilled birth attendance and facility-based delivery, the reduction of maternal and neonatal mortality across many low- and middle-income countries (LMICs) has plateaued, and the rate of stillbirths has increased [1,2]. Global attention to the impact of quality of care on health care outcomes highlights that poor quality, rather than a lack of utilization, drives a significant proportion of LMIC mortality and morbidity. Two reports from 2018 estimate that 5–8 million deaths, representing over 60% of deaths in LMICs, occur due to poor quality care [3,4]. More specifically, data from the Lancet Commission on High Quality Health Systems indicates that 86,000 maternal deaths, 520,000 stillbirths and 670,000 neonatal deaths in the 81 Countdown to 2030 collaboration countries could be averted if adequate quality of care is provided in their health systems [5].

Cesarean delivery (CD) is the most commonly performed surgical procedure among women worldwide, and the most common surgical procedure performed in many LMIC facilities [6]. A CD can be life saving for both mother and child, and yet, if provided with poor quality, can contribute to maternal, fetal and neonatal morbidity and mortality. As such, CD provision offers a window into the overall quality of care a system provides around childbirth and can act as ‘a canary in the coal mine’, demonstrating key areas needed for improvement and operational targets. In this review, we examine quality of care around CD in LMICs using the framework of quality of care proposed by the 2001 Institute of Medicine report, where quality is operationalized into 6 domains: *equity, effectiveness, efficiency, safety, timeliness,* and *patient-centeredness* [7] (Table 1). We review the current evidence available on CD in each of these domains to identify gaps in knowledge, discuss potential metrics for tracking, and identify solutions to achieve improvement in CD care in LMICs.

Domain 1: Equity

The global average CD rate has been steadily rising and has almost doubled from an average of 12.1% in 2000 to 21.1% in 2015 [8]. There are notable regional differences in the world. Latin American and Caribbean countries have experienced steep increases over the last 15 years with a combined average CD rate of 44% in 2015. In contrast, rates in much of sub-Saharan Africa remain low with almost no increase over time, and average rates of 4.1–6.2% across the continent in 2015 [8]. Within-country inequities in CD rates are also well described. Disaggregation of national level CD rates by wealth quintile, education status and geographic location (urban vs rural), reveal significantly higher rates of CD among richer,

urban, more educated women compared to poorer, rural and less educated women [8–10]. These findings underscore that low rates at the national level can mask potential overuse of CD in some subpopulations and a dire lack of access in others [9]. In Ghana, for example, national CD rates more than tripled from 3.7% in 2003 to 16% in 2017 achieving a national level population rate that could be considered adequate [11,12]. However disaggregating the 2017 CD rate reveals rates of 12% in the poorest fifth of the population compared to 46% in the richest fifth [12]. In some countries with little or no change in national average, inequalities in cesarean rates are rising. In the United Republic of Tanzania for example, the national average rose from 3.2% in 2004 to 6% in 2016, however the gap between the poorest fifth and richest fifth widened from 7.7 percentage points in 2004 to 13.4 percentage points in 2016 [13,14]. Perhaps most concerning is decreasing access to CD among poorer subpopulations that are documented in some countries. In Nepal, for example, demographic and health surveys demonstrate increasing rates of CD in the richest fifth of the population (from 13.4% in 2011 to 25.1% in 2016) but a decline in rates in poorest fifth of the population (from 2.7% in 2011 to 2.4% in 2011) [15]. Steeper increases and relatively higher use of use of CD in private versus public facilities may account for some of the differences noted between segments of the population, as richer, educated, and urban women are more likely to use private facilities compared to poorer, less educated and rural women [8]. These disparities in rates also suggest there are significant barriers to accessing CD in the poorer, less educated and rural segment of LMIC populations that must be investigated and addressed. However, differences in sociodemographic characteristics have also been found to persist at the facility level, where women in the wealthiest quintiles had 2.4 times greater use of CD than women in the poorest quintile, suggesting that even once women reach a health facility, factors other than clinical indication alone determine their risk or access to a CD [8].

While the optimal population-based CD rate remains controversial, rates higher than 10–19% at the population level are not associated with reductions in maternal and perinatal mortality and may instead increase harm [16,17]. Thus, unlike other health interventions, such as immunization, antenatal care, or skilled attendance at delivery, where achieving universal coverage is the goal, optimizing CD access is much more complex. Inequities do not only represent poor quality due to a lack of access but may also represent poor quality due to provision of some unnecessary procedures. This is not without consequence. CD without medical indication is associated with increased rates of maternal mortality and morbidity in the index pregnancy and contributes to increased risk of complication in future pregnancy [17,18]. Moreover, unnecessary CD may also impact the neonate, with decreased rates of maternal-infant skin-to-skin contact, early initiation of breastfeeding and kangaroo mother care, and higher rates of neonatal intensive care requirements for those neonates born by CD [19,20].

In countries with extremely low rates, increasing national averages while maintaining equity is an important, albeit complex challenge. As a first step, more active and sustained monitoring of equity in CD rates at global, national, regional, sub-regional and institutional levels, with attention paid to which women are receiving cesarean deliveries and those who are not, is needed. Currently in many LMICS, national tracking at this level relies on demographic and health surveys or multiple cluster surveys. While these surveys have

proven useful to provide an initial understanding of trends towards inequity, their infrequent collection, occurring every three to five years, prohibits real time tracking and response. Currently few facilities in LMICs routinely track the sociodemographic characteristics needed to inform equity [21]. Where possible, collection of this information at the facility level could contribute to more real-time tracking of equity in CD, allowing a more nimble response from policy-makers aiming to improve equity in their populations.

Domain 2: Effectiveness

To improve equity in CD provision, and to reduce the risk for potential harm, another important step is to ensure that CDs are only performed when medically indicated. Despite low population-based national CD rates, there is evidence of high and rapidly rising facility rates across much of sub-Saharan Africa and South-East Asia [22]. These rates may reflect a concentration of CD occurring in a limited number of facilities; however, there is also increasing evidence that a considerable proportion of CDs are performed without medical indication or for questionable indications [23–28]. In Tanzania and Burkina Faso for example, audits at facilities with high CD rates found non-medically indicated CD in 12–30% of cases, with higher rates of non-justified CD performed by providers with less training, for example, clinical officers and general practitioners versus obstetrician-gynecologists [25,27].

Historically, studies reporting on facility-based CD rates in SSA have been limited both in scope and methodology with few studies examining CD, and those that do, using indication for procedure to describe and analyze CD and trends [29–31]. Such methodology is fraught with challenges; most indications for CD are not mutually exclusive and have low reproducibility, preventing comparisons across facilities and over time [32]. To enable improved benchmarking and comparisons across facilities, the Robson Classification System has been recommended by both the World Health Organization (WHO) and the International Federation of Gynecology and Obstetrics as a global standard for assessing, monitoring and comparing CD rates within heath care facilities, over time and between facilities [16,33]. In this system, deliveries are categorized into 10 groups based on maternal parity, onset of labor, prior CD, fetal presentation, number of neonates, and gestational age at delivery. This system benefits from parameters that are prospective, mutually exclusive, and totally inclusive [16]. Since its implementation, use of the Robson Classification system has rapidly expanded; however, most studies with this system have been conducted in Europe, North America and Latin America, with fewer in sub-Saharan Africa and South-East Asia [34]. Broader implementation of this system would provide the opportunity to compare inter-facility, inter-regional and international differences in practice and inform the implementation of evidence-based strategies to optimize CD in certain groups. For example, studies using the Robson Classification system to analyze CD in LMICs indicate that women with a prior CD (Robson group 5) are the fastest growing group contributing to rising CD rates [23,35,36]. This understanding can also inform efforts to control CD rates and emphasizes the need to ensure the appropriateness of the first CD in a woman [37]. This concept of “preventing the first cesarean” may seem irrelevant in settings with low national CD rates; however, the rapid rise in facility rates in LMICs and the consequent increased contribution of repeat CD to overall rates indicates this highly applicable to prevent the

domino effect of CD. This is particularly relevant in settings with high fertility rates, as each subsequent CD increases the risk of complication in contexts where limited resources bring significant maternal and fetal monitoring and safety challenges associated with trial of labor after cesarean, and where fewer resources (e.g. blood bank, interventional radiology, intensive care, surgical specialists) are available to manage complications should they occur. [18].

Optimizing CD rates by increasing use of evidence-based guidelines is challenging and calls for a multi-pronged approach. First, more evidence is needed to understand decision-making for CD in LMICs. In the few studies examining provider motivations in sub-Saharan Africa, themes of fear of blame and lack of transparency have emerged as motivating decision making, with less of an emphasis on financial benefit or malpractice [38]. In this context, the perception of safer outcomes, particularly for the newborn, may motivate premature CD to avoid poor outcomes such as stillbirth or uterine rupture. A better understanding of how such factors in influence decision-making in the local context is important to guide the development of interventions that can successfully drive change [39,40]. Second, rigorous pre-service training on evidence-based guidelines for CD as well as continuous medical education on guidelines is critical. This is particularly relevant, when task-shifting is employed to improve access to CD; training in the evidence-base around decision-making for the CD is just as important as the technical components of the procedure. Third, identifying strategies to disseminate and train more obstetric providers in reasonable alternatives to CD is necessary and often overlooked. Assisted vaginal delivery by forceps or vacuum extraction is declining in high income countries, and experience is even more limited in LMICs. Just 1% of all deliveries in LMICs are performed by vacuum, compared to 3–16.4% in high income countries [41]. Many second stage labors are more safely managed with these techniques rather than a second stage CD, which can be the most challenging and dangerous time to perform a CD. Training providers in low resource settings in the use of assisted vaginal delivery is feasible and has been successfully demonstrated [42–44]. Efforts are needed to provide this content in the primary training of obstetric providers in LMICs, including those incorporated into teams for task-shifting of CD. If CD can be taught through task shifting, assisted vaginal delivery can also be taught and also should be included as an essential element of basic and comprehensive obstetric care. Fourth, improving provider to patient ratios may also contribute improved ability to adhere to evidence-based guidelines. Some of the lowest ratios of midwives, nurse midwives, and obstetricians to pregnancies are seen in sub-Saharan African countries, with ranges from less than 0.15 providers per 1000 pregnancies to 2 providers per 1000 pregnancies [45]. Overwhelming numbers of patients at facilities may prompt premature CD simply to alleviate overburdened staff unable to safely monitor and care for patients at their facilities [38]. Increased support and funding to enable the scale of up obstetric providers can thus also support efforts to improve for effective use of resources. Finally, audit and feedback of CD rates is important to understand trends and drivers of CD rates, and adherence to the use of evidence-based guidelines in decision-making for CD. Such audit and feedback can be a tool to optimize rates as demonstrated in some settings [46,47]. These methods should be investigated as a means of optimizing rates in settings where both underuse and overuse of CD may occur.

Domain 3: Efficiency

Operationalizing efficiency as a domain for evaluating quality has been challenging, particularly for surgical care [21,48]. Efficiency is closely tied to the domains of effectiveness and equity. Ineffective use of an intervention leads to waste of valuable resources; similarly, inequitable use of CD also wastes limited resources if unnecessary procedures are performed in some segments of the population. These diversions extend far beyond the operating room. Women undergoing CD have longer lengths of stay in the hospital, require more post-operative monitoring and management, have higher rates of antibiotic usage, and have higher rates of readmission [49–51]. Whether human, infrastructure, or supply related, overuse in one segment of a population has a direct impact in the quality of care available to other segments of the population in need of CD, or for other obstetric or non-obstetric conditions that may benefit from the use of these resources.

In many LMICs, optimizing equity may have the benefit of improving care by redistributing access and also improving efficiency. In a 2008 analysis, the cost associated with global ‘excess’ of CD procedures was estimated to be ~US$2.32 billion, and the global ‘need’ for CD estimated at US$ 432 million. This demonstrates the inefficiency of the global system at that time, and the opportunity for improvement as the global level ‘excess’ CD could cover the global ‘need’ 5 times over [52]. Such redistribution at the global level is impractical. However, at a national or sub-national level such an evaluation could uncover a potential source of resources for redistribution that would improve outcomes both for women with unnecessary cesareans and women lacking access.

Improving the efficiency of CD use requires tools to help facilities monitor and benchmark overuse and underuse. The C-Model was developed by the World Health Organization as a tool to aid in estimating the expected caesarean section rate in health facilities using the characteristics of the population [53]. This model was developed from a sample of close to 40,000 women delivering across 22 countries, tested in a population of over 10 million women delivering in 43 countries and demonstrated good model performance in test groups. Combined with the Robson classification system, the C-Model can provide an assessment of both efficiency and effectiveness. A facility-based study from Egypt demonstrates the potential utility of both the C-model and the Robson classification system for assessing efficiency and effectiveness [54]. Using data from 1000 consecutive births and the C-Model online calculator [55], a CD rate of 45% +/− 1.3% was predicted, however a CD rate of 61.3% was observed, indicating that efficiency of resources could be gained by reducing the CD rate in this facility. Further analysis by Robson group classification highlighted particular areas to target. The largest deviation from predicted rates were in Robson groups 1 and 3 (nulliparous and multiparous women respectively, with no previous CD and a singleton, cephalic, term pregnancy in spontaneous labor) and least in Robson group 9 (all women with a singleton pregnancy in a transverse or oblique lie). This finding highlighted particular areas for optimization within the facility. Further research is needed in LMICs to inform the use of the C-model to effect change and optimize CD rates.

Domain 4: Safety

Two recent publications report on peri-operative outcomes after CD in sub-Saharan Africa and LMICs. The first provides evidence from 183 facilities in 22 sub-Saharan African countries prospectively collecting mortality and morbidity data after CD over a 7-day period [56]. The second is a systematic review and meta-analysis that reports pooled evidence from close to 3 million cesarean deliveries in LMICs [57]. The findings from these two studies are sobering: a mortality rate of 0.5–1% for women undergoing CD in sub-Saharan Africa and LMICs and stillbirth and perinatal mortality rates of 82.4 and 100.4 per 1000 procedure rates, respectively. These rates are 40 to 100 times higher than those seen in high income countries. Moreover, morbidity rates were also high, with 17% of women experiencing a complication in the prospective sub-Saharan studies. Other studies also report on high rates of iatrogenic injury, in particular, of iatrogenic fistula (i.e. non-obstetric) after CD [58,59]. In one study, 20–25% of new cases of fistula represented iatrogenic injury from poor surgical technique, with CD accounting for the majority of these technical errors [58]. High rates of complication may stem from more complex procedures due to delayed timing, however, they also raise questions around safety standards and practices available in LMIC settings.

One such safety practice is the WHO Surgical Safety Checklist, which has been recommended as a tool to improve adherence to peri-operative safety standards and to improve teamwork and communication between surgical staff. Reductions in mortality by up to 50% have been demonstrated in post-operative morbidity and overall mortality with use of the checklist [60]. However, global uptake of this tool has been inequitable, with uptake of 30% in low-income countries compared to close to 90% in high income countries [61]. Main drivers for poor uptake include lack of availability of the checklist, lack of staff to perform the checklist, length of the checklist, and attitude [62,63]. Widespread use of smartphones amongst health providers along with new tools such as the WHO Safe Surgery Checklist app developed by WHO and the United Nations Institute for Training and Research (UNITAR) [64] may overcome some of the challenges of availability, length, and staff, but additional implementation research to understand how to best develop systems that lead to higher use of this checklist in LMICs are needed.

However, even with improved and sustained use, checklists alone will be insufficient to overcome current safety challenges. Improving safety around CD requires targeting the spectrum of inputs needed to provide safe surgery, and there is good evidence that there are deficits in many of the human, infrastructure, and supply chain resources needed to provide safe surgery [65]. First, shortages in the surgical workforce needed for safe surgery in LMIC are well described. While LMICs account for 48% of the world’s population, only 20% of this workforce (including 15% of anesthesiologists and 29% of obstetricians) practice in these settings, with sub-Saharan Africa and South-East Asia the most undeserved [66]. Reviews of infrastructure and supply chains around CD provision also show severe deficits. Several reports indicate that CD rates have risen sharply with little to no accompanying increase in the number of theatres or equipment within facilities to provide CD, indicating overburdening of likely outdated facilities[67]. In another report from 26 LMICs, common reasons cited as barriers to performing CD were inconsistent access to functioning equipment, oxygen supply, anesthesia supplies, and blood banks [68].

In 2015, the Lancet Commission for Global Surgery identified ten areas of improvement needed for the performance of safe surgical and anesthesia care: (1–3) an adequately trained workforce (surgeon, anesthetist, nursing); (4–5) infrastructure, equipment, supplies, and drugs needed along with a supply chain that allows consistent availability; (6) decontamination and sterilization capacity; (7) safe and affordable blood supply; (8) 24 hour surgical coverage; (9) quality improvement processes including audit of peri-operative outcomes; and (10) risk assessment and planning for procedures [69]. Many of these targets require substantial increases in funding to support improvements. However, innovative strategies such as leveraging remote telemonitoring and teaching for training, using block chain for supply chain management, drones to facilitate blood delivery, and wireless vital sign monitoring to improving monitoring may overcome traditional financial constraints and extend capabilities [70–74]. Beyond these ‘hard’ inputs, attention to improvements in facilities to systems of care, such as morbidity and mortality reviews, processes for team communication during and between shifts, simulation training for emergencies, and adequate supervision of trainees and junior providers are also critical to improving safety standards around CD provision in LMICs.

Domain 5: Timeliness

The vast majority of cesarean deliveries in sub-Saharan Africa are done as emergencies, even for women with antenatally determined indications [56]. This emergent timing dramatically increases the risk for complications. In the above referenced review of perioperative outcomes after CD in LMICs, mortality increased two-fold in emergency CD, increased with advancing stage of labor, and up was up to 12 times higher for a CD conducted in second stage of labor compared to scheduled or elective CD [57]. Risk of perinatal mortality similarly increased; up to 5-fold in emergency cases compared to scheduled, and up to 9-fold when performed in the second stage of labor. Emergency procedures provide little opportunity for pre-operative planning and resource optimization. Women with known risk factors for hemorrhage (e.g., high order repeat cesareans, previa, accreta, or fibroids and a pre-labor indication) are best operated on during daylight hours when staff with more expertise and access to resources such as blood and imaging may be available. With hemorrhage as the leading cause of maternal mortality and mortality after cesarean, and an increasing proportion of pregnancies complicated by a prior cesarean, reducing the proportion of emergency cases is critical to reducing morbidity and mortality[1,57]. Beyond mortality, timeliness of intervention, or rather lack thereof, contributes to poor outcomes following prolonged or obstructed labor, including obstetric fistula and stillbirth. In a study of over 4000 women with obstetric fistula conducted in Tanzania, Uganda, Kenya, Malawi, Rwanda, Somalia, South Sudan, Zambia and Ethiopia, 52% were delivered by CD, with stillbirth present in over 80% of women undergoing CD [75].

Current models of obstetric care delivery may need reconsideration to fully address timeliness of access to CD. WHO policy recommends that most women deliver in primary care facilities where basic emergency obstetric and newborn care is available. While this policy promotes access to facilities close to women’s domiciles, it presumes that women with complications can be referred appropriately. Accumulating evidence points to

dysfunctional referral systems, where referrals are often made too late, and referral mechanisms (i.e., transport) are inadequate or unavailable. In women with a prior CD where repeat CD is indicated or where national or subnational policy dictates repeat CD, delays in presentation to facilities capable of performing CD contributes to increased risk. In one study of women with a previous CD, over one third of women presented to the facility in an advanced stage of labor, and close to 10% in the second stage [76]. In another study, among women with previous CD as the sole indication, 85% presented as urgent or emergent cases [77]. Fundamental health system redesign calling for structural reforms to enable all women to deliver in facilities with life-saving obstetric and newborn care, including CD, have been proposed as an imperative to achieving substantial reductions in maternal and neonatal morbidity and mortality [78]. This proposal stems not only from the evidence that current systems are insufficient to meet needs as described, but also to address a current global double standard where women in high income countries have such access, while a tiered health system is proposed for maternal care in low income countries [78].

Timeliness within a facility capable of performing CD also merits consideration. Historically, guidelines from professional organizations in high income countries recommend a standard of initiating an emergent CD within 30 minutes of decision-making [79,80]. This target is controversial, particularly in LMICs where data is limited and findings are conflicting on the impact on birth outcomes. [81–85]. While the benefit of a 30-minute target is unclear, and indeed the feasibility of achieving this even less certain in both high- and low-income settings, prolonged delays in LMICs have been reported with median times ranging from 2–5 hours from decision to delivery. Deliveries at the upper end of these ranges are associated with poor outcomes [85–87]. Furthermore, while a standardized time target for decision to delivery in LMICs remains undefined, high rates of intrapartum stillbirth among women undergoing CD point to failures in monitoring and timeliness and the need for improvement in this quality domain. Achieving such improvement will require a combination of both resource improvement and system strengthening. Infrastructure and resource limitations including sharing operating room facilities with other non-obstetric services, staff and supply shortages, and water and power outages are frequently reported as reasons for delays. Resource improvement alone has proven insufficient to change timeliness. Equal attention to improving communication and coordination between multidisciplinary teams, clinical training, and system strengthening is needed.

Domain 6: Patient-centered care

Providing care that is patient-centered requires recognition that ultimately any health care provided must not only improve outcomes for the patient, but also value the patient's experience, needs, and values. Patient-centered care has further been elaborated in six dimensions: 1) respect for patient's values, preferences, and expressed needs 2) coordination and integration of care 3) information, communication, and education 4) physical comfort 5) emotional support – relieving fear and anxiety and 6) involvement of family friends [7]. As the most common surgical procedure performed in women, incorporating these six dimensions into the provision of CD is essential. This is critical both for women who may desire CD and for those who would prefer vaginal delivery where possible.

CD by maternal request is often cited as a reason for rising global rates; however, there is a growing body of literature documenting a preference for vaginal delivery amongst most women [88]. Even in Latin America, where national CD rates are the highest globally, less than 25% of women express a preference for a cesarean birth. In Asia and sub-Saharan Africa, studies report the vast majority of women, 80–90%, prefer vaginal delivery over CD [38,89–91]. In some reports, up to 10% of women refuse CD even for medical indications directly related to maternal or newborn wellbeing [92]. Although reasons for the preference for vaginal delivery vary from region to region, common explanations include fear of death, fear of pain, social consequences e.g., failure of womanhood, financial consequences, and inadequate counselling and education[38,90,92–95]. These fears are rooted in the reality of peri-operative outcomes as described above, but also may also stem from incomplete or lacking education, counseling, and respectful attention from potentially overworked and overburdened health providers. Even for women without complications, the experience around a CD can be negative with several studies reporting lack of attention from health providers, limited pain management, and insufficient pre- and post-procedure counseling for women undergoing the procedure [96,97]. In addition, women may face impoverishing and catastrophic expenditures as a consequence of undergoing CD, with some of the financial consequences still present even four years after the index CD [95,98]. These findings indicate that rising global CD rates are in direct opposition to the values, desires, and needs of women undergoing cesarean with real social consequences. Moreover, they indicate notable gaps in meeting the six dimensions of patient centered care described above and the need to improve the experience for women where a CD is medically indicated.

Data on patient-centered dimensions with respect to quality are limited, however mobile technology provides a promising opportunity to gather more information on patient satisfaction and experience around childbirth in general and around CD specifically. Use of mobile technology for such data collection has been piloted in Kenya, where mobile surveys were used to collect patient-reported outcomes using standard data sets developed by the International Consortium for Health Outcome Measurement [99]. These sets include measurement of patient satisfaction, quality of life, mental health, and patient-reported health status. Collection of patient-reported outcomes through mobile based platforms such as this offers a potential sustainable strategy to enable real-time, scalable collection of patient-reported outcomes around CD that provide actionable data for quality improvement efforts at facilities and in health systems.

An Action Agenda

Though quality of care has garnered increasing global attention, operationalizing this concept and transforming it into discrete and actionable quality improvement efforts with accountability has proven challenging. Using CD to provide insight into the quality of care in LMICs offers a potential strategy that not only provides an actionable framework, but also addresses a key component of safe motherhood that is critical for achieving improvements in maternal and newborn outcomes and meeting sustainable development goals. In this review we have provided an overview of quality of care around CD using the six domains framework provided by the Institute of Medicine.

We end this review by providing an initial template for tracking metrics of quality around CD provision using the six discussed domains and supported by the quality gaps described above. Measuring quality is challenging and historically has been inadequate in LMICs [21,100]. However, such measurement is essential to provide accountability, track progress, and in itself can be an agent of change. Quality assessment tools with explicit metrics have been proposed for evaluation of surgical care[48] and maternal and newborn care[101–103]; however, to our knowledge, there is no unified set of metrics for measuring quality around CD. Prior tools have been based both on the Institute of Medicine domains of quality, and the Donabedian theory of quality, which proposes three dimensions: structure, processes, and outcome to help guide quality assessment [48,100,104]. We present an adapted version of the surgical quality of care tool proposed by Citron et al with metrics tailored to specifically measure quality of care around CD (Table 2). The suggested metrics are preliminary; research will be needed to establish the feasibility and sustainability of collecting these measures at the facility, sub-national, and national level, particularly in LMICs. Given limited resources in many LMICs, it is also important to identify which metrics prove most efficient in tracking several quality domains and whether metrics can be obtained from routinely collected information without the need of additional data collection efforts. Furthermore, establishing regional and/or global consensus on a uniform set of metrics will also be essential to allow benchmarking across time and between facilities and countries.

Conclusion

CD is and will remain a key intervention in safe motherhood. With increasing access to this procedure globally, including in LMICs, our attention must also be focused on ensuring high levels of quality around the provision of this procedure. Such attention requires measurement tools to support systematic and sustained facility and health system change. Only then can the full promise that this intervention holds for women and their future newborns be realized.

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Table 1:

Quality of Care Domains as proposed by Institute of Medicine [7]

Domain	Definition	Domain	Definition
 Equity	Delivering health care which does not vary in quality because of personal characteristics such as gender, race, ethnicity, geographical location or socio-economic status	Patient-centeredness 	Providing care that is respectful and responsive to individual preferences, needs and values and ensuring that patient values guide all clinical decisions.
 Effectiveness	Providing services based on scientific knowledge and evidence-based guidelines	Safety 	Delivering health care which minimizes risks and harm to service users, including avoiding preventable injuries and reducing medical errors
Timeliness 	Reducing delays in providing/receiving health care	Efficiency 	Delivering health care in a manner which maximizes resource use and avoids wastage

Table 2:

Suggested metrics for quality assessment around cesarean delivery

		INSTITUTE OF MEDICINE DOMAINS					
		Equitable	**Effective**	**Efficient**	**Safe**	**Timely**	**Patient-Centered**
DONABEDIAN FRAMEWORK	**Structure**	• Financial assistance for CD (government subsidies, insurance)	• Supervision systems for trainee providers • Pre-service/in-service training • Continuing Medical Education	• Operating rooms for CD use • Beds reserved for CD patients • Staffing for CD provision • Antibiotic stewardship	• Morbidity and Mortality conferences • Safety rounds • Simulation training • Infrastructure & equipment availability	• Regional referral systems including for antenatal indication for CD	• Patient education and counseling
	Process	• Average distance/cost to access facility capable of CD provision • Cost to patient of obtaining CD	• Proportion of CD with evidence-based indications for cesarean • Provider to patient ratio	• Bed occupancy rate • Length of stay • Antibiotic usage rate	• Proportion of CD with safe surgery checklist usage • Provider to patient ratio	• Time from decision to delivery • Travel time to delivering hospital	• Proportion of women with informed consent for CD • Proportion of women receiving post-operative pain management
	Outcomes	• CD rate by income, education, geographic location of origin, ethnicity • Rate of impoverishing or catastrophic expenditure	• CD rate by Robson classificatio n group	• C-Model	• Peri-operative morbidity and mortality rate • Iatrogenic fistula rate	• Obstetric fistula rate • Uterine Rupture • Intrapartum Stillbirth Rate	• Patient satisfaction

*CD – Cesarean Delivery