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Beyond utilization: measuring effective coverage of obstetric care along the quality cascade

ELYSIA LARSON[1], DANIEL VAIL[2], GODFREY M. MBARUKU[3], REDEMPTA MBATIA[4], and MARGARET E. KRUK[1]

[1]Department of Global Health and Population, Harvard T. H. Chan School of Public Health, 665 Huntington Avenue, Bldg 1, 11th floor, Boston, MA 02115, USA, [2]Stanford University School of Medicine, 291 Campus Drive, Palo Alto, CA 94305, USA, [3]Ifakara Health Institute, P.O. Box 78373, Plot 463, Kiko Avenue, Mikocheni A, Mwai Kibaki Road, Dar es salaam, United Republic of Tanzania, and [4]Tanzania Health Promotion Support, 3rd Floor, Coco Plaza Bldg, Plot 254, Masaki Dar es Salaam, United Republic of Tanzania

Address reprint requests to: Elysia Larson, Department of Global Health and Population, Harvard T. H. Chan School of Public Health, 665 Huntington Avenue, Bldg 1, 11th floor, Boston, MA 02115, USA. Tel: +1-617-365-5776; E-mail: ell539@mail.harvard.edu

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Abstract

Objective: To determine the effective coverage of obstetric care in a rural Tanzanian region and to assess differences in effective coverage by wealth.
Design: Cross-sectional structured interviews.
Setting: Pwani Region, Tanzania.
Participants: The study includes 24 rural, government-managed, primary healthcare clinics and their catchment populations. From January–April 2016, we conducted a household survey of a census of women with recent deliveries, health worker knowledge surveys and facility audits.
Main Outcome Measures: We explored the proportion of women receiving quality care through the cascade and conducted an equity analysis by wealth.
Results: In total, 2,910 of 3,564 women (81.6%) reported delivering their most recent child in a health facility, 1,096 of whom delivered in a study facility. Using a minimum threshold of quality, the effective coverage of obstetric care was 25%. Quality was lowest in the emergency care dimensions, with the average score on the provider knowledge tests at 47% and the average provision of basic emergency obstetric services below 50%. The wealthiest 20% of women were 4.1 times as likely to deliver in facilities offering at least the minimum threshold of quality care through the cascade compared to the poorest 80% of women (95% confidence interval: 1.5–11.3).
Conclusions: Effective coverage of delivery care is very low, particularly among poorer women. Health worker knowledge caused the sharpest decline in effective coverage. Measures of effective coverage are a better performance measure of under-resourced health systems than utilization. Equity analyses can further identify important discrepancies in quality across socio-economic levels.
Trial Registration: ISRCTN 17107760.

Key words: health services research, measurement of quality, effective coverage, maternal and newborn health

Introduction

As the global community reflects on progress made toward Millennium Development Goal 5, it is clear that improvements made to maternal mortality have not been consistent across countries. In developed countries, the maternal mortality ratio dropped by >50% from 1990 to 2013, while in developing countries, the reduction was only 26.7% [1]. However, coverage of maternal health services is on the rise in developing countries, where ministries of health and development partners have maintained focus on encouraging utilization of healthcare in an effort to reduce mortality.

There is substantial evidence supporting the use of skilled attendants at delivery to reduce maternal and newborn deaths [2, 3]. However, facility deliveries are not always associated with improved maternal health outcomes, and a recent review found higher mortality for women delivering in health facilities [4]. While it is likely that some of the deaths are due to delayed arrival at health facilities by women with complicated and high-risk pregnancies (selection bias), others could be due to poor quality of care during labor and delivery [5, 6].

It is thus important that measuring progress in maternal healthcare moves beyond measures of nominal facility utilization for delivery to measures of effective coverage of delivery care. Measures of effective coverage weight utilization estimates by the quality of the services used [7, 8]. Recent publications have found effective coverage to be substantially lower than measures of utilization [7, 9, 10]. However, these studies did not link facility measures of quality to the population and therefore did not look at differential effective coverage by maternal characteristics.

In this article, we use linked population and facility data to assess the effective coverage of obstetric care for women in rural Tanzania, explore the bottlenecks in effective coverage and estimate wealth-based differences in receipt of effective care.

Methods

Context

This analysis was conducted using cross-sectional data from a cluster-randomized maternal and newborn health quality improvement study in Pwani Region, Tanzania: MNH+ (ISRCTN 17107760). The MNH+ study includes 24 government-managed primary healthcare clinics (dispensaries) and households within the clinics' official government-designated catchment areas. The clinics are within four rural districts where most individuals are employed in agriculture or unskilled labor [11]. The study setting has been previously described in detail [12].

In Tanzania, the frequency of home delivery varies by wealth: 65.5% of women in the lowest wealth quintile delivered at home compared to 9.5% of women in the wealthiest quintile. On average in Tanzania, the proportion of home deliveries decreased marginally from the 2004–05 Demographic and Health Survey (DHS) to the 2010 DHS from 52.7% to 48.1% [11, 13]. However, some regions saw a substantial decrease in home births. Home deliveries in Pwani Region, the setting for this study, decreased from 57.0% to 25.1% in just 5 years.

Study design and fielding

Data were collected from three sources—household interviews, health worker interviews and facility audits. Women living in the catchment area of one of the study dispensaries, who were at least 15 years of age and had delivered a child within the year prior to interview, were invited to participate in the household interview. All households in the catchment area were enumerated. The full subset of women delivering in study facilities was analyzed here. Prior to interview, women provided written consent or in the case of minors, written assent together with guardian consent. Household data collection occurred between 20 January 2016 and 7 April 2016. The household survey was developed in English, translated into Swahili, and then back translated to English to check for consistency. Locally trained Tanzanian research assistants conducted all household surveys in Swahili.

All health workers working in the study facilities at the time of data collection were invited to participate in health worker interviews. Skilled health workers (e.g. clinical officers and nurses) were given a 60-question, multiple choice test administered in English, the language of medical instruction. In addition, all skilled health workers as well as unskilled health workers who reported routinely providing obstetric care (e.g. maternal and child health aides) were administered two oral vignettes by a trained nurse. Data collection occurred from 25 January 2016 to 4 April 2016.

Facility audits were conducted in the 24 study facilities from 25 January 2016 to 25 February 2016. Data collectors interviewed the health worker in charge of the facility or the most senior health worker available on the day of visit. The health worker was asked questions about services provided in the facility. Data collectors also observed current stocks of equipment, supplies and medications, and abstracted monthly count data from medical health registers for January to December 2015.

The household survey and facility audits were conducted using handheld tablets with SurveyCTO software (2016 Dobility, Inc.) The provider tests and vignettes were collected on paper and then entered into the Census and Survey Processing System (CS PRO, US Census Bureau and ICF Macro) by two separate data enterers. Discrepancies were resolved with review of the paper survey. Completed surveys were exported from either SurveyCTO or CS Pro into CSV files and imported into Stata for analysis.

Measures and analysis

We define any coverage as the proportion of all births that were performed in any facility, measured through the household survey. We further assess births that occurred in the study facilities to measure the level of effective coverage across five dimensions of maternal health quality: facility infrastructure; availability of equipment, supplies and medicines; health worker knowledge and competence; provision of routine obstetric services; and provision of emergency obstetric and newborn services. The tracer indicators for each dimension of quality are outlined in Table 1. Tracer indicators were combined to create a composite indicator for each dimension of care. Tracer indicators for equipment, supplies and medications were determined from the Tanzanian Ministry of Health required list, previously reported indices, and an expert review panel [14–16]. Mean health worker scores on the 60-item knowledge test and two clinical vignettes were calculated for each facility. The knowledge tests demonstrate health worker knowledge, while clinical vignettes provide a measure of the quality of clinical practice [17]. Tracer indicators for routine care (care that should be provided for all mothers and babies) include indicators for infection control, monitoring of labor and diagnosis of complications. Each indicator was measured as a proportion of all deliveries recorded in facility registers from January through December of 2015; these proportions were summed to create a score for routine care. One tracer indicator, maternal blood pressure, was not measured in 2015 at one of the study facilities due to the use of a different register. For this

Table 1 Composition and proportion of facilities having each input for each dimension of quality ($n = 24$)

Quality dimension	Proportion or mean (range)[a]
Clinic infrastructure (maximum 3)	2.0 (1–3)
1. Toilet facilities	96%
2. Electricity	75%
3. Clean water	29%
Clinic equipment, supplies and medicines (maximum 27)	17.9 (12–25)
1. Stainless steel bowls	100%
2. Stethoscope	100%
3. Uterotonic	100%
4. Magnesium sulfate	96%
5. Nevirapine for baby	96%
6. Blood pressure cuff	92%
7. Neonatal ambu-bag and mask	92%
8. Sutures	92%
9. Disinfectant	92%
10. Cord clamps	92%
11. Delivery kit	88%
12. Infant and/or child scale	88%
13. Partographs	88%
14. Intravenous fluids	83%
15. Thermometer	75%
16. Gloves	67%
17. Hemoglobin test kit	67%
18. Injectable antibiotic for mother	54%
19. Delivery table	42%
20. Sterilization equipment	42%
21. Clock	38%
22. Mucus suction	38%
23. Hydralazine	29%
24. Neonatal antibiotic	17%
25. ATC[b] for mother	17%
26. Nevirapine for mother	12%
27. Examination lamp	0%
Clinic health worker knowledge/skills (maximum 100%)	47% (34–54%)
1. 60-question multiple choice knowledge test	51%
2. Two clinical vignettes	44%
Routine obstetric and newborn care for delivery (maximum 6)[c]	4.7 (3.6–5.6)
1. Baby breastfed within 1 h	97%
2. Apgar score	95%
3. HIV test	95%
4. Baby weighed	92%
5. Maternal blood pressure	69%
6. Partographs	20%
Emergency obstetric and newborn care for delivery (maximum 6)	2.5 (1–6)
Provided in the last 3 months:	
1. Uterotonic	100%
2. Removal of retained products of conception	42%
3. Newborn resuscitation with bag and mask	38%
4. Parenteral antibiotics	33%
5. Parenteral anticonvulsants	21%
6. Manual removal of placenta	17%

[a]Across all 24 study facilities the proportion of deliveries that received the indicated service.

[b]Apricitabine.

[c]Average proportion of all deliveries recorded in facility registers from January through December of 2015.

facility, data from 2014 were used. For a second facility, data were missing for 1 month and calculations were made omitting this single month of data. Basic emergency care was assessed through report of service provision in the past 3 months. The services included represent those recommended by the Tanzania Ministry of Health and international organizations [16, 18].

For each dimension of quality, we calculated the average score across all facilities. The average scores across all facilities were the mean knowledge score for the clinic health worker knowledge and skill dimension and mean input score for the additional four dimensions. We also assessed the number of facilities reaching either the 'high' or 'minimum' threshold of quality. Facilities met the 'high' threshold for each dimension of care if all the tracer indicators were near complete (≥90%) or for the knowledge and skill dimension if the average health worker score was 80% (the examination threshold for adequate performance.) [19] Facilities met the 'minimum' threshold with 50% completion of indicators (Table 2). These thresholds are similar to those previously used to assess the cascade of obstetric care [7, 20]. For assessment of population effective coverage, we calculated the proportion of women who delivered in facilities providing good care on successive dimensions of quality, beginning with basic infrastructure, followed by equipment and supplies, health worker knowledge and competence, provision of routine obstetric services and ending with provision of basic emergency obstetric care. We examined which elements of care were the greatest bottlenecks to effective coverage.

In addition, we conducted an equity analysis to assess the difference in effective coverage by wealth. We conducted five bivariate logistic regressions where the exposure for each regression was wealth, comparing the least poor 20% of the population to the poorest 80%. The five outcomes we assessed were receipt of at least the minimum level of quality at each point in the quality cascade. We used logistic regression with robust variance estimation to adjust for dependence of women delivering in the same facilities. Wealth was determined using a principal component analysis of a set of 18 household assets. Stata version 13.1 (StataCorp LP, College Station, USA) was used for all analyses.

Ethical considerations

The study was approved by ethical review boards at Columbia University and Harvard University in the USA and the Ifakara Health Institute and the National Institute for Medical Research in Tanzania.

Results

In total, 3,575 women participated in the survey (response rate of 94.6%.) Of these women, 3,564 had complete delivery information; 2,910 women (81.6%) reported delivering their most recent child in a health facility. Of the women who delivered in a health facility, 1,096 (37.7%) delivered in an MNH+ study facility, for which we have quality data. Most women in the study sample were married or living with their partner, Muslim and farmers or homemakers (Table 3).

Analysis of audit and health worker data showed that the quality of facility inputs (basic infrastructure and equipment, supplies and medications) was higher than the quality of processes (health worker knowledge and competence and provision of emergency care), except the provision of routine services, which was 78%. While the

Table 2 Criteria for high or minimum quality across each dimension

Quality dimension	High quality		Minimum quality	
	Criteria	*N* (proportion) of facilities meeting criteria	Criteria	*N* (proportion) of facilities meeting criteria
Clinic infrastructure (maximum 3)	Has water, electricity and a toilet	6 (25%)	Has at least water	7 (29%)
Clinic equipment, supplies and medicines (maximum 27)	≥25 indicators	1 (4%)	≥14 indicators	23 (96%)
Clinic health worker knowledge/skills (maximum 100%)	Average health worker knowledge score is 80% or higher (a passing score)	0 (0%)	Average health worker knowledge score is 50% or higher	8 (33%)
Routine obstetric and newborn care for delivery (maximum 6)	Coverage of routine services is at least 90% for all deliveries (score is ≥5.4)	2 (8%)	Coverage of routine services is at least 50% for all deliveries (score core is ≥3.0)	24 (100%)
Emergency obstetric and newborn care for delivery (maximum 6)	Performed all six BEmONC functions in past 3 months	1 (4%)	Performed at least three BEmONC functions in the past 3 months	9 (38%)

Table 3 Descriptive statistics of women delivering in Pwani region, Tanzania (2015, 2016)

	Women delivering in study facilities (*N* = 1,096)
Demographics	
Age (mean)	27.7
Education (categorical)	
No formal	24%
Some primary	10%
Completed primary	54%
Any secondary	12%
Farmer or homemaker	77%
Muslim	79%
Married or living with partner	82%
Household assets	
Mobile phone	90%
Electricity	20%
Motorcycle	20%
Delivery characteristics	
Primipara	16%
Delivery at facility	100%
Community characteristics	
Village has paved road	40%

average score on equipment, supplies and medicines was 67%, the average knowledge score was <50% (Table 1). This meant that while almost half of the women delivered at a facility with high-quality infrastructure, <10% of women delivered at a facility offering high-quality routine or emergency obstetric care and no women delivered at a facility where the providers met the threshold for high quality on the knowledge and competence tests (Figure 1).

Using the higher threshold of quality, 48% of women delivered at a facility with adequate infrastructure; 7% of women delivered at a facility with adequate infrastructure and adequate equipment, supplies and drugs; and 0% of women delivered at a facility with these elements and adequate health worker knowledge.

Using the minimum threshold of quality, 55% of women in the full sample received good care through the infrastructure stage, 50% through the equipment, supplies and drugs stage, 33% through the knowledge and competence stage, 33% through the routine care stage and 25% through the BEmONC stage. The major bottlenecks—elements responsible for the greatest drop in effective coverage—were availability of clean water, health worker knowledge and provision of emergency services (Figure 2).

Wealth data were available for 1,091 (99.5%) women; of whom, 51.5% of women in the wealthiest quintile and 5.8% of women in the poorest quintile delivered in facilities that met the minimum threshold of quality for all dimensions of quality. Compared to the poorer 80% of women, the least poor 20% of women were more likely to deliver in a good quality facility at each point in the cascade: wealthier women were 8.5 times as likely to deliver in a facility with at least the minimum threshold of clinic infrastructure (95% CI: 3.5–20.4); 9.9 times as likely to delivery in a facility with the minimum threshold of infrastructure and clinic supplies, equipment and medicines (95% CI: 4.5–22.1); 6.9 times as likely to deliver in a facility with the minimum threshold of infrastructure, supplies and clinic health worker knowledge/skills (95% CI: 2.6–18.8); 6.9 times as likely to deliver in a facility with the minimum threshold of infrastructure, supplies, health worker knowledge, and routine obstetric and newborn care for delivery (95% CI: 2.6–18.8) and finally 4.1 times as likely to deliver in a facility that had the minimum threshold of all elements of quality including emergency obstetric and newborn care for delivery (95% CI: 1.5–11.3).

Discussion

Even though >80% of women delivered their most recent child in a health facility, effective coverage of delivery care among women delivering in their local primary care facility was very low among this rural Tanzanian population. Applying a conservative standard (90% completion of required elements), the effective coverage was zero. With a more permissive standard of 50% completion of quality elements, effective coverage was 25%.

The greatest bottlenecks along the quality cascade were clean water, health worker knowledge and provision of emergency care. Healthcare facilities performed better on input measures, such as infrastructure and equipment availability. These results likely reflect the focus of Tanzanian policies on increasing the number of facilities and facility inputs and the relative lack of attention—and difficulty—of improving the delivery of care [16, 21]. In order to identify health system weaknesses in need of support, implementers need

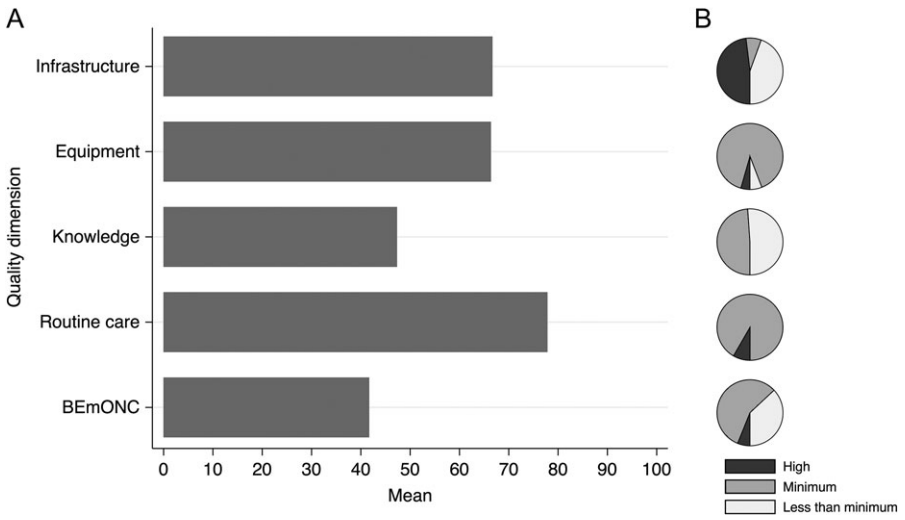

Figure 1 Average facility performance (**A**) and proportion of women who received the minimum or high-quality standard of care for each dimension of quality[1] (**B**). [1]See Table 2 for detailed description of thresholds.

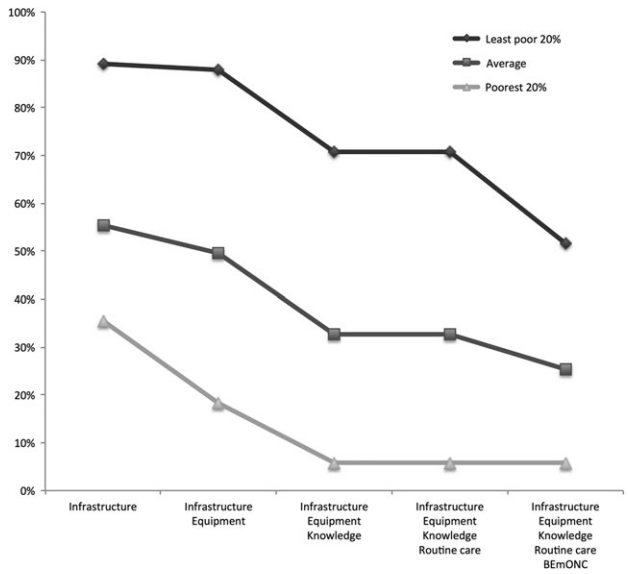

Figure 2 Cascade of effective coverage by wealth status: proportion of women receiving at least the minimum threshold of quality[1] as each additional dimension of quality is assessed (n = 1,096 women). [1]A woman has delivered at a facility meeting the minimum threshold of quality if the facility has at least 50% of the inputs in that domain.

to look beyond measures of health system hardware and focus on provider competence and actual provision of services. Some promising results have been identified in relation to focusing on provider training for PMTCT and resulting intrapartum quality improvement [15, 22]. Improving quality may serve the dual purpose of providing safe care for women and increasing their utilization of high-quality facilities as past research has shown that indicators of process are important to women's perceptions of quality of care [23, 24].

Numerous studies have documented inequities in access to obstetric care in sub-Saharan Africa due to education, wealth and rural versus urban location [25–28]. However, a recent cross-country analysis found that rapid increases in the proportion of deliveries attended by skilled birth attendants were associated with improved equity [29]. Our findings indicate that among women who use primary care facilities for deliveries, poor women are less likely to receive good quality care than women in the wealthiest quintile. There are several potential explanations for this disparity. Poorer women may live in more remote areas where the number of skilled and experienced healthcare providers may be lower, thus contributing to the poor quality in local facilities [30, 31]. In addition, wealthier women may be better informed about quality of care and may have more resources to travel to higher quality facilities if they are not available nearby. Further exploration of these potential mechanisms is needed.

While this is the first study to our knowledge to identify inequities in effective coverage by household wealth, the observations on poor quality of facility care identified in this study are consistent with similar findings in the region [7, 9, 10, 32]. Given similar health system financing and human resource constraints in other sub-Saharan African countries, it is likely that the inequities identified here are not unique to rural Tanzania. Future work on measuring and improving the quality of healthcare services should include assessment of equity.

Our study has several limitations. First, the data used here are not representative at the national level. Second, the facility-level data only assess deliveries at primary care clinics and not hospitals or health centers. The most recent Tanzanian Service Provision Assessment found that 75% of primary care facilities offered delivery services but that these facilities had fewer trained staff and equipment for delivery services than health centers and hospitals [33]. This suggests that the effective coverage seen in our study may be lower than that provided by higher level clinics. However, the current policy in Tanzania encourages deliveries at the primary care level and half of the women in this study deliver in such clinics, highlighting the importance of assessing quality at this level [16]. Third, thresholds for minimum quality have not been empirically defined in the context of primary care delivery in low-income countries, requiring somewhat subjective judgment of what constitutes adequate care. However, the threshold selected for minimum quality (50% completion) was permissive and thus represents the best-case scenario. In addition, indicators for routine services were limited to

those recorded in the facility registers. While facility register data have been under-reported compared to observation data in other settings [34], the high recording in this setting does not suggest under-reporting. Finally, the evaluation of effective coverage is conducted from facility-level data and may not reflect the actual experiences of each individual woman on the day of her visit.

Conclusion

Using facility utilization measures as an indicator of progress toward safe motherhood can be misleading. Our findings indicate that despite high coverage of facility deliveries, the care delivered in primary healthcare facilities was of low quality. We further find that poor women suffer from the double burden of lower facility utilization and lower quality of delivery care. As the global community turns its attention toward universal health coverage, it will be crucial to measure the content and quality of that coverage as well as its equitable distribution across all levels of care.

Author contributions

E.L. and M.E.K. conceptualized the study question and measurement design. E.L. and D.V. conducted the analysis. E.L. drafted the manuscript. M.E.K. oversaw data analysis and interpretation and edited the manuscript. D.V., G. M.M. and R.M. contributed to interpretation of the analysis and edited the manuscript. All authors read and approved the final manuscript.

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