Accuracy of Patient Perceptions of Maternity Facility Quality and the Choice of Providers

Zeina Ali Siam[1], Margaret McConnell[2], Jessica Cohen[2]

ABSTRACT

Background. Delivering in high-quality maternity facilities is key to averting preventable maternal and newborn mortality. Accuracy of pregnant women's perceptions of facility quality, and how these perceptions affect their facility choices, are not well-understood.

Objectives. This study aimed to assess: 1) the accuracy of pregnant women's perceptions of maternity facility quality and 2) the association between perception accuracy and the quality of facility chosen for delivery.

Methods. 64 facilities in Nairobi, Kenya were assessed for key routine and emergency obstetric and newborn care ("signal") functions. An index of facility quality was constructed based on the fraction of these signal functions a facility performed. 180 women were surveyed during pregnancy about their perceptions of quality at the delivery facilities they were considering and later about their ultimate facility choice. A binary variable for perception accuracy was constructed by comparing a woman's ranking of facilities based on her perception of their quality to the index ranking. OLS and logistic regressions were used to analyze associations between perception accuracy and quality of the facility of chosen for delivery.

Results. Assessed technical quality was poor, with an average index score of 0.66. 39% of women in the sample had accurate perceptions of quality ranking. Relative to inaccurate perceptions, accurate perceptions were associated with delivery in a facility with a 0.064 (p=0.031) higher quality index score and with 0.367 (p=0.033) lower odds of delivering within the bottom quartile of the quality index.

Conclusions. Patient misperceptions of quality are associated with use of lower quality facilities. Larger studies could determine whether improving patient information about relative facility quality can encourage use of higher quality care and lead to better delivery outcomes.

[1] Harvard Graduate School of Arts and Science. Email: siamz@g.harvard.edu

[2] Harvard TH Chan School of Public Health

INTRODUCTION

Most of the 1.3 million maternal deaths occurring in sub-Saharan Africa each year result from conditions that are treatable or preventable with high-quality care [1]. Nearly one-third of deaths in the first 24 hours of life are attributed to a lack of simple measures such as skin-to-skin contact, and correct cleaning of the umbilical cord, and around 75% of maternal deaths are due to preventable and/or treatable causes like infections and severe bleeding post-delivery [2, 3].

Recent studies in Africa find high variability in maternity facility quality and highlight inadequate facility quality as a major challenge to maternal and neonatal mortality reductions [4, 5, 6]. One study has shown that as much as 88% of facilities in five African countries lacked the capacity to perform c-sections, and another shows that high coverage of basic essential services may not be enough to reduce mortality rates without improving technical quality [5,6]. In Nairobi, Kenya, where this study takes place, hundreds of widely-varying maternity facilities operate. These facilities are not well-regulated and many do not meet minimum quality standards, such as the capability to treat pre-eclampsia and newborn asphyxia [7]. Despite the fact that delivery in Kenyan public hospitals is free, and that nearly every woman in Nairobi delivers in a facility, maternal and newborn mortality rates in the informal settlements of Nairobi are among the highest in the world [7].

A number of studies from Africa provide evidence that women have strong stated and revealed preferences for delivering in high-quality maternity facilities [8, 9, 10, 11]. While most women would prefer to deliver in a well-equipped facility, many of them do not. Previous studies have found that facility cost and distance, as well as women's education and cultural beliefs, influence the choice of delivery facility [12]. Several studies in low-income countries have shown that pregnant women seem to have some information about provider quality and that their perceptions of quality influence their facility choice [13, 14]. For example, some studies have found that women will bypass nearby facilities and travel farther to reach delivery facilities they perceive to be higher quality [13, 14].

While pregnant women largely seem to prefer to delivering at high-quality providers, the extent to which women can perceive quality accurately is not known. Asymmetric information about provider quality is a well-known driver of market failures in health [15,16]. Inaccurate perceptions of provider quality are likely to be severe for pregnant women because obstetric and newborn complications are rare and the technical skills of maternity providers are hard to observe. Several studies have tried to explore questions pertaining to information asymmetry by, for example, investigating women's reliance on quality metrics in their decision-making or their understanding of the metrics [17, 18]. However, none of these studies have explored the accuracy of women's perceptions of facility quality and the degree to which misperceptions of quality may be contributing to the use of lower quality care.

This study aims to determine the accuracy of perceptions of maternity facility quality among a sample of pregnant women in Nairobi, Kenya and to analyze the extent to which accurate perceptions are predictive of delivering in a higher quality facility. Nairobi is a novel and important setting for this research given the complex maternity provider landscape and the extremely high rates of obstetric and newborn morbidity and mortality rates.

METHODS

Study participants and data collection

This study uses data collected for a randomized controlled trial described in detail in Cohen *et al* (2017) [19]. The study took place between 2015 and 2016 in 24 neighborhoods within the informal settlements ("slums") surrounding Nairobi, Kenya. These neighborhoods are densely populated and quite poor, with limited access to modern sanitation and social services [20]. Pregnant women were recruited through community recruitment events, community health worker listings, and snowball sampling. Consenting women were enrolled in the study if they were in their 5th-7th month gestation, were at least 18 years old, were planning to stay in Nairobi until at least two weeks postpartum, and were intending to deliver at a health facility. Women were surveyed at three-time points: Baseline (5th-7th gestational month); midline (8th gestational month); and endline (2–4 weeks after delivery).

The baseline and midline surveys captured basic demographic information and pregnancy-related history. The endline survey captured detailed information about the woman's delivery, including her facility of choice. At baseline and midline, three-fourths of the sample was asked a series of detailed questions about their perceptions of quality at the facilities they were considering for delivery. Women were asked to list all of the facilities they were considering, which were written on paper and cut out. Women were then asked to rank the facilities on a visual analog scale from best to worst on a number of different dimensions, including general quality and ability to handle complications.

Information about the facilities where the women delivered was also collected. The facility assessment was adapted from the Averting Maternal Death and Disability (AMDD) program's emergency obstetric and newborn care (EmONC) Needs Assessment Toolkit. The AMDD toolkit was developed collaboratively with Ministries of Health and UN agencies to assess inputs including infrastructure, supplies, equipment, and materials for EmONC. Additionally, the tool collects information about performance of signal functions of routine obstetric and routine and emergency newborn care proposed by Gabrysch *et al* and Tripathi *et al* [22, 23]. The assessment includes interviews with facility staff members and direct observation of the facility's supplies, records, and physical structure and conditions. All but 15 facilities targeted for assessment were assessed, leading to 64 assessments in total. The primary reasons not completing an assessment among targeted facilities were facility administrative delays and permanent facility closure. More details on the timeline of the data collection process is provided in Section 1 of the Appendix.

Measure of facility quality

We used data from the facility assessment to create an index of 23 quality variables based on signal functions used in literature [4, 21, 22]. Signal function performance has been shown to correlate strongly with health outcomes [23]. The index includes facility-reported signal functions for routine and emergency obstetric and newborn care services (detailed in Supplementary Table A1). Routine signal functions include items such as practicing basic infection control and using a partograph to monitor labor. Emergency signal functions include administrating parenteral oxytocin for post-partum hemorrhage and parenteral antibiotics

for newborn sepsis. The index is equal to the fraction of these signal functions performed at a facility. We ranked facilities' quality levels by their index values.

Measure of accuracy of quality perceptions

We created a measure of accurate perceptions of facility quality using women's rankings during their 8th gestational month (the midline survey). This variable is equal to 1 if the woman's ranking of facilities matched the actual ranking based on the quality index. Given that women's choice set size consisted mostly of 2 or 3 facilities (91.6% of the sample), our exposure took a binary form of accurate versus inaccurate perceptions. If a woman had tied facilities, her perceptions would only be accurate if the facilities' quality levels were equal per their index value.

Sample

553 women were surveyed at baseline. Among these, 459 women and 454 women were reached for midline and endline, respectively. Attrition was primarily due to temporary relocation around the time of delivery to be with family members, with some attrition coming from miscarriage or newborn mortality. Cohen *et al* (2017) discusses sample composition and attrition in detail [19].

The study sample is constructed from the women surveyed at midline who were also randomly selected to be asked about facility quality perceptions (n=334). We then restricted the sample further. First, women had to be considering more than one facility for delivery, in order for us to assess her quality ranking (n=280). Second, we restricted the sample to women whose choice set included at least two assessed facilities (n= 221). Finally, we only included women whose actual delivery facility was assessed. The final sample included 180 women and 42 assessed facilities. We show in the appendix that this study sample has very similar characteristics to the full baseline sample recruited for the study.

Statistical Methods

The primary outcome is the quality of facility used for delivery, as measured by the quality index. In order to explore the relationship between the accurate perceptions variable and the quality index for the

delivery facility used, we used multivariate OLS regressions. All adjusted regressions control for treatment arm from the original RCT, neighborhood location, gestational month at baseline, and the number of facilities in a woman's choice set. We also include dummy variables for choice set size (2, 3 or 4+ choices), a category variable indicating if she had c-section history or not, or whether the child is a first birth, a binary variable equal to one if the woman reported receiving any information from a health worker about her current pregnancy being high-risk, as well as socio-economic status (how difficult it is to collect an amount of 1,000 ksh), educational attainment (secondary education or higher), marital status (married versus not), and self-reported health insurance status (insured versus not).

We also explore the probability of delivery in a facility in each quartile of the quality index and in facilities at different levels of the health system (primary health center, hospital, and tertiary hospital).

We tested the robustness of our results with sensitivity analyses including different measures of facility quality. We first used the quality index published in Kruk *et al* [4], which includes both process quality measures that overlap with our index, but also includes structural quality measures such as referral capacity, electricity and safe water availability. The other quality measure tested is a 7-item subset of our full index, which includes only the widely-referenced Basic Emergency Obstetric and Newborn Care (BEmONC) signal functions [24]. The components of the two measures are provided in the Appendix (Section 3).

Since women's ranking of facilities by quality could be based on a number of different dimensions that are not captured in our index, we also conducted a sensitivity analysis using a more narrowly-defined measure of quality perceptions. For this measure, women were asked to rank facilities specifically on their (perceived) ability to handle emergencies. We then compare the accuracy of their perceptions of this particular dimension of quality, to an index comprising only the 17 items in our index related to emergency management (i.e. excluding routine care measures).

RESULTS

The mean quality index for the 42 delivery facilities used by women in the study sample was 0.661 (se = 0.235), meaning that the average facility performed 66.1% of the signal functions for routine and

emergency obstetric and newborn care. The index ranged from 0 to 0.95 across facilities. Supplementary Table A1 presents facilities' performance for each item in the index. There is wide variation in the performance of these signal functions, with most of the facilities reporting administering parenteral antibiotics and oxytocin for maternal sepsis and (pre-) eclampsia and very few reporting conducting assisted delivery (with vacuum or forceps) and low rates of routine infection control practice.

39% of women had accurate perceptions of facility quality. Table 1 presents characteristics of the overall sample and by perception accuracy. On average, women in the sample were 25 years old; 31.7% of them were pregnant for the first time and85.6% were married. Women with accurate perceptions were 10.5 percentage points more likely to have had a previous C-section than those with inaccurate perceptions (p=0.053). No other statistically significant differences between women with accurate and inaccurate quality perceptions were found. Supplementary Table A2 demonstrates that the characteristics of the study sample are similar to the original (full) sample recruited for the study at baseline.

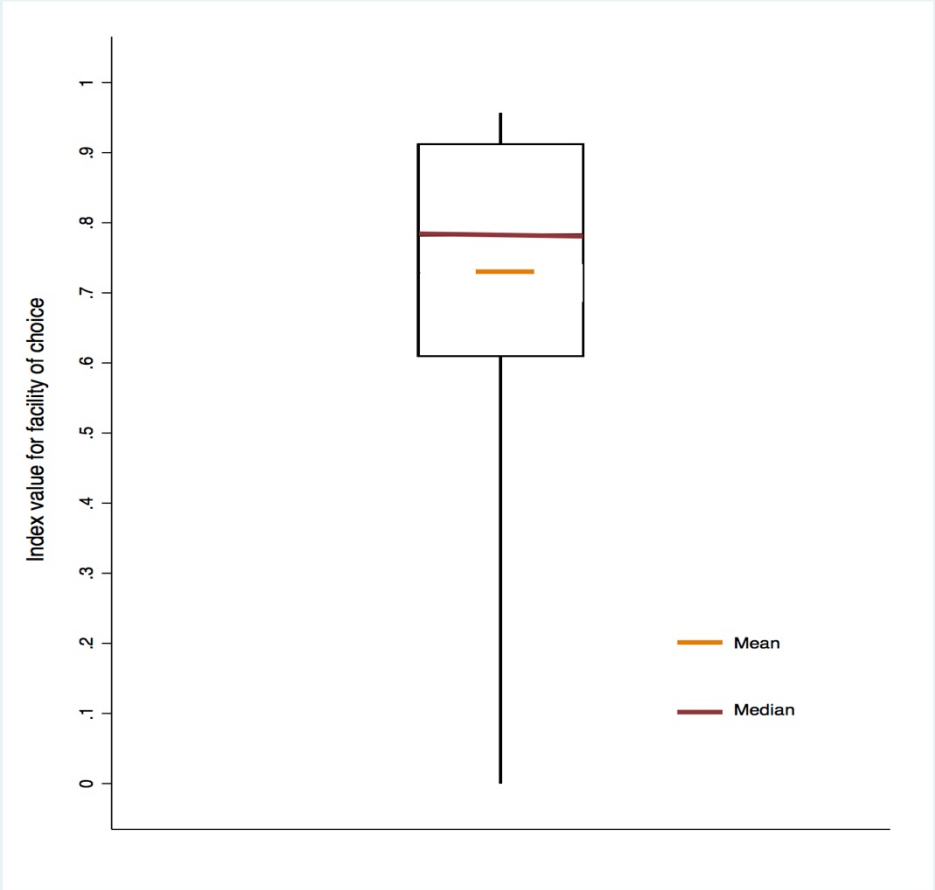
Table 1. Sample Characteristics (N=180)

Mean/percentage (se)	Overall sample	Inaccurate perceptions	Accurate perceptions	p-value on Test of Equality: (2)=(3)
	(1)	(2)	(3)	(4)
Mean age, years	25.34 (4.73)	24.88 (0.45)	26.21 (0.58)	0.068
Married	85.56 (0.35)	83.63 (0.04)	88.89 (0.04)	0.322
Any Secondary or Postsecondary Education	65.56 (0.48)	70.00 (0.04)	58.33 (0.06)	0.106
Electricity in household	98.89 (0.24)	92.7 (0.03)	95.71 (0.02)	0.648
Would be "difficult" or "very difficult" to pay roughly $10 for treatment if household member became ill†	60.00 (0.49)	60.00 (0.05)	60.00 (0.06)	0.999
Health Insurance	0.38 (0.49)	41.82 (0.05)	31.94 (0.06)	0.179
First pregnancy	0.32 (0.47)	33.64 (0.05)	27.78 (0.05)	0.405
Antenatal visits, number	2.99 (1.05)	3.02 (0.10)	2.93 (0.13)	0.583
Previous C-section (among those with with previous birth)	9.83 (0.30)	5.48 (0.03)	16.00 (0.05)	0.053
People with whom delivery location was discussed, number	0.54 (0.76)	0.55 (0.07)	0.53 (0.09)	0.878
Informed y providerto have a high risk pregnancy	8.33 (0.38)	7.27 (0.025)	9.72 (0.04)	0.556

Notes. † Amount converted from Kenyan Shillings (1000) to US Dollars using April 2017 conversion rate of 0.0097. All values are from the midline survey and are self-reported. Where missing, baseline values were used.

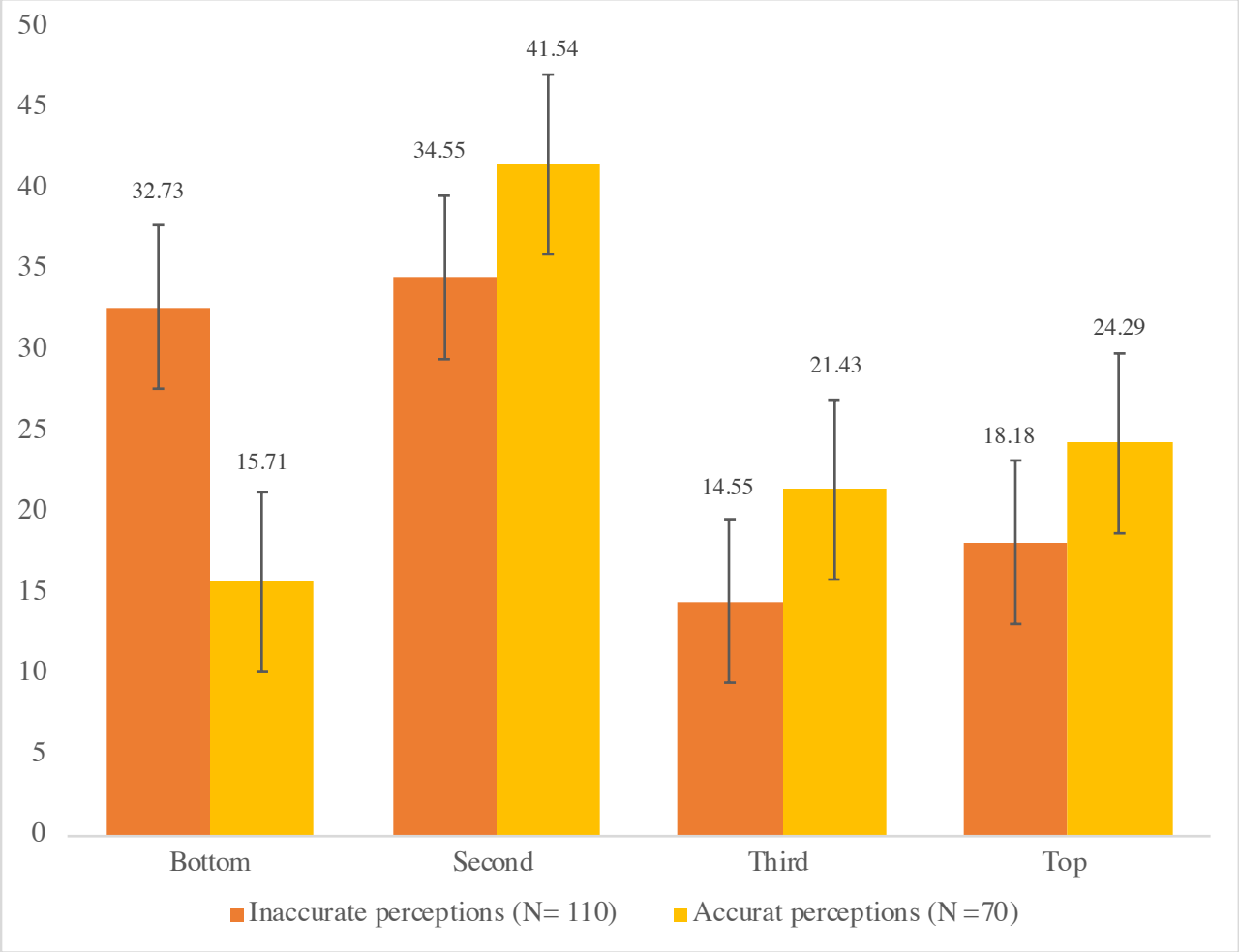
The distribution of quality levels for the facilities used by women in our sample is presented in Figure 1. The mean quality of facility used for delivery was 0.73 and the median was 0.78. Having accurate perceptions of facility quality is associated with an increase in the quality index of the facility used for delivery of 0.077 (p=0.008) in the unadjusted model and of 0.064 (p=0.031) in the adjusted model (Table 2). Figure 2 demonstrates the fraction of women delivering in facilities of each quartile of the quality index. Nearly 33% of women with inaccurate perceptions deliver in the lowest quartile facilities, compared with 15.7% among women with accurate perceptions (p=0.033). Regression coefficient estimates associated with this figure are presented in Supplementary Table A3, along with adjusted and unadjusted logistic regression models of the association between perception accuracy and delivery in a facility in each quartile of the quality index distribution.

Figure 1. Distribution of Quality Index among Facilities Used for Delivery (N=180)



Notes. Box plots presenting the distribution of the index measure for final facilities of choice in the overall sample of 180 women. Top and bottom horizontal boundaries of the boxes show the 25th and 75th percentiles, respectively, while the extending top and bottom vertical lines denote the 95th and 5th percentiles, respectively.

Figure 2. Fraction of Women Delivering in Each Quartile of Quality Index, by Perception Accuracy



Notes. Quartile ranges: Bottom (0.0-0.608); second (0.652 - 0.783); third (0.826- 0.913); top (0.956 - 1.0)].

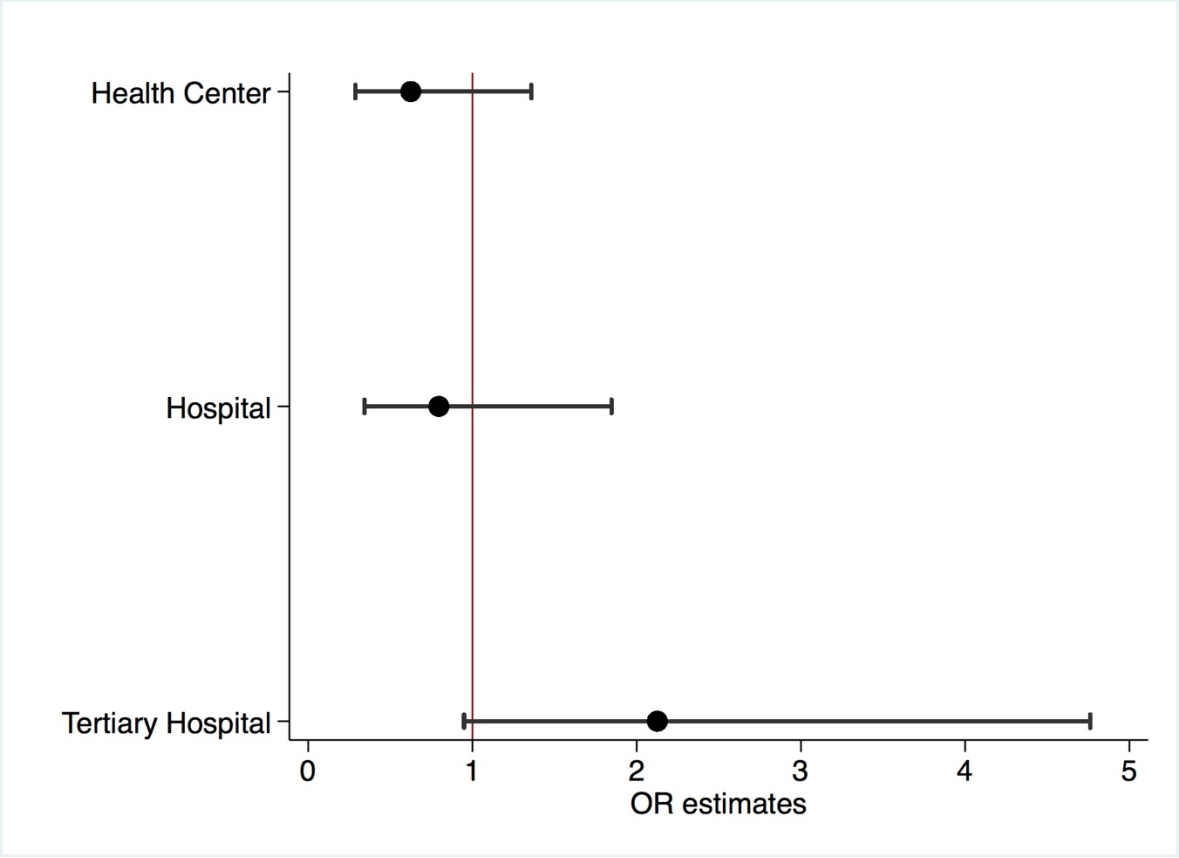
Table 2. Regression Estimates of Association between Perception Accuracy and Quality of Delivery Facility (N=180)

Variable	Unadjusted			Adjusted		
	Estimate (se)	95% CI	p-value	Estimate (se)	95% CI	p-value
Correct perceptions of quality	0.077 (0.029)	[0.021, 0.133]	0.008*	0.064 (0.031)	[0.006, 0.123]	0.031*
Antenatal visits				0.023 (0.011)	[0.001, 0.046]	0.040*
Very Difficult to collect 1000 Ksh				0.017 (0.028)	[-0.040, 0.073]	0.562
Secondary education or higher				-0.062 (0.029)	[-0.118,-0.004]	0.035*
Choice set size (Ref = 2)						
3				-0.024 (0.038)	[-0.099, 0.052]	0.003*
4+				0.116 (0.038)	[0.04, 0.191]	0.538
Insurance (self-reported)				0.009 (0.030)	[-0.051, 0.068]	0.778
C-section (Ref = No; not first pregnancy)						
Yes				0.197 (0.043)	[0.112, 0.282]	0.000*
No, because first pregnancy				0.131 (0.033)	[0.067, 0.196]	0.000*
Information about risk in pregnancy				0.000 (0.066)	[-0.130, 0.131]	0.999
Married				0.002 (0.047)	[-0.088, 0.094]	0.952

Notes. Ordinary least squares regressions. All covariates are measured at midline, and missing values are imputed with values reported as baseline. Robust standard errors were used.

Multivariate logistic regression estimates of the relationship between perception accuracy and the odds of delivery in a higher level facility are presented in Figure 3. Correct perceptions are associated with 0.62 lower odds of delivering in a primary health center and 2.13 higher odds of delivering in a tertiary hospital, but these associations are not significant at conventional levels (p=0.235 and p=0.067).

Figure 3. Multivariate logistic regressions of delivering in facilities by level (N = 180).



Supplementary Table A4 presents OLS regression estimates of the relationship between accurate perceptions and the two alternative facility quality measures. These results are consistent with our main results, with accurate perceptions associated with a roughly 5-6 percentage point increase in the quality index used in Kruk et al [2016] and with an increase of roughly one item (out of seven) in the number of BEmONC signal functions in the facility used for delivery. Supplementary Table A5 presents the sensitivity analysis focusing on women's perceptions of a facility's ability to handle complications. We find similar, though somewhat less precise, results with accurate perceptions of the facility's emergency capability associated with a 5.6 percentage point increase in the value of the index composed of the 17 emergency care measures ($p = 0.073$ in the adjusted model).

DISCUSSION

This study demonstrates that pregnant women often misjudge the quality of available maternity facilities. We also find that having accurate perceptions of quality is not correlated with measures of socioeconomic status, but is correlated with having had a prior c-section. We find that accurate perceptions are modestly predictive of use of higher quality facilities and, in particular, are protective against delivery in the worst facilities.

Several factors likely contributed to the observed inaccuracy in quality perceptions. First, the maternity landscape in Nairobi, Kenya is complex and women face a substantial degree of choice, with hundreds of different options when choosing a maternity facility. Second, most women do not deliver in the facility they used for prenatal care and there is not a strong role of referral in Nairobi, so that women face a large part of the burden of learning about possible delivery facilities. We find some evidence that prior experience with high-quality facilities may influence women's perceptions of quality, as a prior c-section (which presumably happened at a better-equipped facility) is predictive of accurate perceptions.

Our study has several strengths. To the best of our knowledge, this is the first study that attempts to quantify the accuracy of patient perceptions of maternity facility quality. We assess quality perceptions

in a novel and important context in which women have the choice of many widely-varying providers and where the choice of facility can have serious consequences for delivery outcomes. It is also one of the first studies to assess the relationship between stated quality perceptions and facility choice longitudinally, so that perceptions are captured *prior* to facility choice. Many studies assess the relationship between patient-reported experiences and assessed facility quality, where patients' reports are measured after their experience of care[25, 26]. Since perceptions of quality are clearly influenced by the experience of care, it is difficult to use these ex-post stated perceptions to analyze the choice of facility. Our results are also shown to be robust to different specifications, covariate adjustment, and constructions of the dependent and independent variables.

Our study also has several limitations. First, the sample size is limited and results may not be generalizable outside of the population of urban poor in Nairobi, Kenya. Larger studies, in other contexts, are needed to explore the extent to which patients' quality perceptions and the facility they choose varies across settings. It is important to note, however, the significance of the population studied here, as nearly one billion people live in urban slums worldwide and more than half of all births are projected to be in urban areas by 2050 [27, 28]. Second, while our measure of facility quality is derived from commonly-used indicators in the literature, it is based on facility-reported performance of essential functions. A more reliable measure of facility quality would be based on direct observation of routine and emergency care provided at the facility.

There are also several potential limitations to the measure of quality perceptions used in this study, including the use of quality rankings rather than levels. Further, women's perceptions of quality may include factors that are not included in our quality index. We attempt to address this possibility in a sensitivity analysis, but it is likely that patients' perceptions of quality are based on a number of factors that could be hard to capture in a facility assessment (e.g. perceptions of inter-personal quality or cleanliness). More research is needed on which aspects of quality perceptions matter most to women in their choice of delivery facility [29, 30, 31, 32, 33]. A final important limitation is that our study does not necessarily capture the causal relationship between quality perceptions and facility quality. It is possible that

perceptions of quality drive facility choice, but it is also possible that the type of women who have more accurate perceptions of quality are also more likely to deliver high quality places. While we don't find any relationship between socioeconomic status measures and perception accuracy, and our estimates are robust to adjustment for measured confounders, there are clearly a number of potential unmeasured confounders.

The United Nations has set ambitious Sustainable Development Goals, which include target reductions in maternal and newborn mortality by 2030 [34]. In order to accelerate progress toward these goals in sub-Saharan Africa, the policy agenda must move beyond ensuring access to delivery in *any* health facility toward encouraging delivery in a *high-quality* facility. Many of the facilities in our study were ill-equipped to handle common obstetric and newborn emergencies, though our study echoed the wide variation in facility quality that has been found previously in Africa. While our study simply assessed associations, our results are suggestive of the possibility that providing information to pregnant women about the quality of available maternity facilities could steer them away from the lowest quality options. Although many of the attempts to influence patient choice of providers through comparative quality information in high-income settings have been largely unsuccessful [35, 36], it is possible that information about quality could have a stronger influence in contexts such as Nairobi, Kenya, where women regularly switch providers and do not rely strongly on referral.

Author Contributions

ZA Siam implemented the data analysis and wrote the first draft of the manuscript. J Cohen oversaw data analysis and contributed substantially to the editing of the manuscript. M McConnell contributed to the conceptual development of the research question and sensitivity analysis and edited the manuscript. J Cohen and M McConnell led the experimental design and data collection process of the primary data that was used for this paper.

Appendix materials for "Accuracy of Patient Perceptions of Maternity Facility Quality and the Choice of Providers

Appendix Section 1

Facilities were assessed starting at 9 months after the pilot deliveries occurred, with facility assessments occurring on average 13 months after pilot deliveries. An additional 4 facilities were surveyed 24 to 25 months after the pilot deliveries occurred. Because facility assessments were conducted after the deliveries in the pilot study occurred, an additional section was added to assess changes to facility service provision, staffing, and infrastructure in the 12 months prior to the assessment. Information sources include interviews with facility administrators and health providers, direct observation of infrastructure and commodities, and retrospective review of medical records and receipts.

Appendix Section 2

Table A1. Fraction of facilities performing each item in the quality index (N=42).

Quality Index Item	Percentage of facilities performing item
Routine care	
Reported universal practice of:	
1. Infection control (provider hand washing before patient exam in labor, new sterile gloves before every vaginal exam)	64.3
2. Use of partograph to monitor labor	83.3
3. "Active management of third stage of labor": oxytocin administration, controlled cord traction, assessment of uterine tone	85.7
4. Thermal protection for newborn (newborn dried immediately, skin-to-skin initiated, delayed bathing)	61.9
5. Exclusive breastfeeding initiated within an hour of delivery	95.2
6. Umbilical cord cut with sterile blade or scissors	42.9
Emergency care	
Reported practice in the past three months:	
7. Removal of retained products of conception	73.8
8. Parenteral oxytocin for maternal hemorrhage	97.6
9. Parenteral anticonvulsants for (pre-)eclampsia	54.8
10. Manual removal of placenta	69.1
11. Parenteral antibiotics for maternal infection	90.5
12. Assisted vaginal delivery (vacuum or forceps)	26.2
13. Caesarean section	47.6
14. Blood transfusion	40.5
15. Antibiotics given to mother for preterm labor or prolonged rupture of membranes	73.8
16. Parenteral antibiotics for neonatal sepsis	66.7
17. Corticosteroids given to mother for preterm labor	47.6
18. Newborn resuscitation (with bag and mask)	81.0
19. Kangaroo Mother Care practiced for premature/very small newborns	64.3
20. Alternative Feeding for newborns unable to breastfeed	64.3
21. PMTCT if mother is HIV-positive	71.4
22. IV fluids given to newborn	47.6
23. Safe administration of oxygen to newborn	71.4

Appendix Section 3

Table A2. Comparing the distribution of background characteristics of final sample (N= 180) with the original sample at baseline (N=553)

Mean/percentage (se)	Study sample (N= 180)	Original Study Baseline Sample (N = 553)	Test of equality
	1	2	(1=2)
Mean age, years	25.34 (4.73)	25.27 (4.53)	0.8682
Married	85.56 (0.35)	88.43 (0.32)	0.308
Any Secondary Education	65.56 (0.48)	67.09 (0.47)	0.7046
Electricity in household	98.89 (0.24)	92.39 (0.27)	0.5008
Difficult to get 1000 Ksh	60.00 (0.49)	59.60 (0.49)	0.924
Health Insurance	0.38 (0.49)	40.65 (0.49)	0.4142
First pregnancy	0.32 (0.47)	33.82 (0.47)	0.6158
Antenatal care visits	2.99 (1.05)	1.74 (1.11)	NA*
Previous C-section (among those with with previous birth)	9.83 (0.30)	12.39 (0.33)	0.4537
People with whom delivery location was discussed, number	0. 54 (0.76)	41.80 (0.72)	0.0625462
Informed to have a high risk pregnancy	8.33 (0.38)	6.15 (0.24)	0.308

*We could not compare antenatal care visits as the original sample brings data from baseline which inherently translated into fewer antenatal care visits

Appendix section 4

Table A3. Association between perception accuracy and the probability/odds of delivery in a facility in each quartile of the quality distribution (multivariate ordinary least square and logistic regressions; N=180)

Dependent Variable Is:											
Delivered in Bottom Quartile Facility			Delivered in Second Quartile Facility			Delivered in Third Quartile Facility			Delivered in Top Quartile Facility		
Estimate or Odds Ratio (se)	95 % CI	p-value	Estimate or Odds Ratio (se)	95 % CI	p-value	Estimate or Odds Ratio (se)	95 % CI	p-value	Estimate or Odds Ratio (se)	95 % CI	p-value
Ordinary least square regression (unadjusted)											
-0.175 (0.061)	[-0.300 , -0.054]	0.005*	0.035 (0.067)	-0.098, 0.168	0.605	0.081 (0.067)	-0.052 , 0.216	0.229	0.058 (0.068)	-0.075, 0.192	0.388
Ordinary least square regression (adjusted)											
-0.155 (0.068)	-0.290, -0.020]	0.025*	0.011 (0.075)	-0.137, 0.159	0.886	0.124 (0.070)	-0.015, 0.263	0.081	0.020 (0.069)	-0.115, 0.156	0.766
Logistic regression (unadjusted)											
0.357 (0.142)	[0.164, 0.779]	0.01*	1.204 (0.421)	0.606, 2.391	0.597	1.536, (0.535)	0.776, 3.039	0.218	1.734 (0.604)	0.876, 3.431	0.114
Logistic regression (adjusted)											
0.356 (0.166)	[0.143, 0.887]	0.027*	1.037 (0.436)	0.455, 2.366	0.931	2.401, 1.088	0.987, 5.838	0.053	1.152 (0.504)	0.488, 2.716	0.747

Notes. Unadjusted regressions represent naïve regressions of outcome on exposure. Adjusted regressions include the following covariates as midline: Marital status, educational attainment, choice set size, previous pregnancy, C-section history, insurance status, information about risk in pregnancy, and SES status.

Appendix section 5

Sensitivity analysis – test 1

To explore the sensitivity of our results to the construction of the facility quality variable we explore the association between the accuracy of quality perceptions and two other measures of facility quality previously used in the literature. The first measure, used in Kruk *et al*, is a 12-item summative index of quality of basic maternal-care functions consisting of 5 structural indicators and 7 processes of care items [22]. Basic elements of structure were skilled provider availability, referral capacity, electricity, safe water, and resources for infection control in the delivery room. Process indicators included use of partographs, routine practice of active management of the third stage of labor (AMTSL), and five signal functions (capacity to remove retained products, parenteral oxytocin for hemorrhage past 3 months, parenteral magnesium sulfate for [pre-]eclampsia past 3 months, manual removal of placenta past 3 months, and antibiotics for maternal infection past 3 months). The sum of the indicators (maximum 12) was converted into a proportion out of 1. The second measure is the total number BEmONC signal functions that the facility meets, which comprises 7 signal functions [24]. These functions are detailed in items 7-12 and 18 in Table A1. For the first index, we applied a multivariate OLS regression, and for the second index we use a poisson model with robust standard errors.

Table A4. Sensitivity Analysis: Association between Perception Accuracy and Two Alternative Measures of Facility Quality (OLS Regression)

	Unadjusted			Adjusted		
	Estimate (se)	**95 % CI**	**p-value**	**Estimate (se)**	**95 % CI**	**p-value**
Outcome: Kruk et al Index	0.053 (0.024)	0.004, 0.101	0.033*	0.056 (0.027)	0.004, 0 .110	0.036*
Outcome: BEmONC Count	1.124, 0.054	1.022, 1.236	0.016*	1.103 (0.054)	1.001, 1.214	0.048**

Notes. Unadjusted regressions represent naïve regressions of outcome on exposure. Adjusted regressions include the following covariates as midline: Marital status, educational attainment, choice set size, previous pregnancy, C-section history, insurance status, information about risk in pregnancy, and SES status.

Appendix section 6

Table A5. Sensitivity Analysis: Association between Accurate Perceptions of Facility's Ability to Handle Emergency Complications and Facility Quality Based on 17-item Quality of Emergency Care Index (N=180)

	Outcome: 17-Item Quality Index Including Only Emergency Care Signal Functions					
	Unadjusted			Adjusted		
	Estimate (se)	95 % CI	p-value	Estimate (se)	95 % CI	p-value
	0.052 (0.038)	-0.023, 0.128	0.175	0.056 (0.031)	-0.005, 0.116	0.073

Notes. Accurate perceptions was created as a binary variable showing whether a woman's ranking matches the ranking by the 17-item Quality of Emergency Care index. Unadjusted regressions represent naïve regressions of outcome on exposure. Adjusted regressions include the followng covariates as midline: Marital status, educational attainment, choice set size, previous pregnancy, C-section history, insurance status, information about risk in pregnancy, and SES status.

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