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Examining the Impact of Integrated Obstetric Simulation Training on the Quality of Antenatal Care in Northern Ghana

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Abstract

Objectives This study aims to assess if an integrated simulation-based training on respectful maternity care (RMC) and management of obstetric and neonatal emergencies could improve the quality of antenatal care (ANC).

Methods The data are from two cross-sectional surveys administered in the East Mamprusi District of Northern Ghana in 2017 to evaluate the impact of integrated simulation-based training for healthcare providers. Surveys were administered to two groups of women aged 15–49 who delivered in a health facility before (baseline; $n = 266$) and 6 months after (end-line; $n = 320$) the intervention began. We assessed the quality of antenatal care pre- and post-training across two dimensions: service provision and experience of care. Analyses included linear and logistic regression.

Results Women in the end-line group reported higher quality of antenatal care than those in the baseline group. The average ANC experience of care score increased by 10 points at the end-line (Coeff = 10.3, 95%CI: 9.0,11.6), whereas the mean ANC service provision score increased by three points (Coeff = 2.6, 95% CI: 2.2, 3.1). End-line participants were more likely to have an ultrasound (OR: 24.1, 95%CI: 11.5, 50.3). Parity, tribe, education, employment, partner occupation, six or more antenatal visits, ANC facility, and provider type were also associated with ANC quality.

Conclusions Integrated simulation-based training for health providers has the potential to improve the quality of ANC. Incorporating such training into continuing professional development courses will aid global efforts to increase the quality of care throughout the maternity continuum of care.

Significance

As ANC coverage increases globally, there is a need to address issues of quality and equity. Our study based in northern Ghana shows that integrated simulation-based training for healthcare providers could contribute to improved quality of antenatal care in both the experience and service provision domains.

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Introduction

High-quality antenatal care (ANC) is critical for the health of both pregnant women and their unborn babies' health. Having regular contact with a doctor, nurse, or midwife during pregnancy enables women to receive vital services and skilled guidance (Arora, 2019; atzatzev, 2019; UNICEF, 2021; WHO, 2016). Therefore, the World Health Organization (WHO) recommends frequent ANC encounters during pregnancy that foster a positive experience as essential to reducing perinatal mortality, thus modifying its ANC attendance recommendations in 2016 from four visits to eight visits (WHO, 2016). While the proportion of women receiving at least four ANC visits has increased globally over the last decade, coverage rates vary by region, with sub-Saharan Africa and South Asia having the lowest rates of ANC attendance (atzatzev, 2019). Further, as ANC coverage grows, there is a need to address issues of quality and equity (Afulani, 2015; Chukwuma et al., 2017; Manzi et al., 2018).

According to the 2022 Demographic Health Survey, more than 90% of women in Ghana received ANC from qualified practitioners, but about 86% received professional delivery care, and only around 45% received postpartum care (Ghana Statistical Service & DHS, 2024). This implies that, while there is an initial willingness to seek maternity care, that inclination eventually declines for a variety of reasons. One reason for this is the quality of ANC because women's future decisions to seek maternal care in a timely and frequent manner are influenced by their experiences with the health system in the past (Adjiwanou & Legrand, 2013; Afulani & Moyer, 2016; Chukwuma et al., 2017; Kapula et al., 2022). However, there have been very few research studies in Ghana and Sub-Saharan Africa on the quality of ANC (Amponsah-Tabi et al., 2022a; Aryeetey et al., 2015).

There has been no consensus on how to define the quality of ANC because it is multi-dimensional. The WHO vision for quality of care for pregnant women and newborns, however, highlights two broad dimensions of quality of care that are applicable to ANC: service provision and experience of care (Tunçalp et al., 2015). Previous research on ANC in Ghana focused on the timing and sufficiency of services delivered in accordance with the Ministry of Health, Ghana Health Service, and WHO standards (Aryeetey et al., 2015; Duodu et al., 2022; Kotoh & Boah, 2019; Manyeh et al., 2020; Sakeah et al., 2017; Seidu et al., 2022). For instance, Amponsah-Tabi et al., who assessed the quality of ANC in a tertiary hospital in Ghana using interviews and medical chart reviews, found that most women (92.4%) received average to poor quality ANC (Amponsah-Tabi et al., 2022a). ANC quality was assessed using a composite measure that considered the timing of ANC initiation, the number of contacts, and the recommended interventions received. Other studies in Ghana have identified gaps in ANC quality and equity (Afulani, 2015; Atinga & Baku, 2013).

In Ghana, however, there is a paucity of literature on interventions to improve ANC (Duysburgh et al., 2016; Okawa et al., 2019). In a prior study, we collected data on ANC quality in a rural district in northern Ghana to examine the impact of an integrated simulation-based training for healthcare providers on the provision of respectful maternity care (RMC) (Afulani, Aborigo, et al., 2019). The primary aim of this study is to assess whether this intervention improved ANC quality. A secondary objective is to examine patient, provider, and facility-level factors associated with ANC quality in this setting.

Materials and Methods

Study setting, intervention, and data collection

The data for this analysis originated from a prior study that assessed the impact of an integrated simulation-based training for healthcare providers on the provision of RMC in the East Mamprusi District in northern Ghana. The intervention and other study specifics are described elsewhere (Afulani, Aborigo, et al., 2019). In brief, 43 healthcare providers from five health facilities in the district participated in a two-day training on RMC and emergency obstetric and newborn care using PRONTO (https://prontointernational.org/) International's low-tech, highly realistic simulation and team training with facilitated debriefing (Cohen et al., 2011; Walker et al., 2016). The training curriculum focused on patient-provider interactions such as effective communication and autonomy, dignity and respect, supportive care, identifying and managing obstetric and newborn complications, and teamwork and communication. Following the initial training, there were five monthly refreshers. Although the training did not directly address the quality of ANC, we expected that providers would apply the RMC principles learned to all their encounters with patients and be more cognizant of the services needed to prevent complications during ANC.

To evaluate the intervention, trained research assistants administered surveys to women aged 15–49 who gave birth in the study facilities within 8 weeks preceding the survey administration, at baseline before the training ($N = 266$) and at end-line, 6 months after the initial training ($N = 320$). The baseline study was conducted in March and April 2017, and the end-line study was undertaken in November 2017. All study participants provided written informed consent.

The study was approved by the ethics review boards of the University of California, San Francisco, and the Navrongo Health Research Center in Ghana and deemed exempt by the University of Michigan. Study activities were performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. All research participants gave their informed consent prior to their inclusion in the study.

Measures

Dependent Variable: Quality of ANC

The study questionnaire included several questions based on a tool developed and administered in Kenya to assess the quality of ANC on both the experience of care and service provision dimensions (Afulani, Buback, et al., 2019a, 2019b). The original questionnaire was adapted from the ANC questions in the Demographic and Health Surveys (DHS) and the person-centered maternity care (PCMC) scale (Afulani et al., 2017).

Experience of Care

We evaluated the ANC experience of care using the 18 items in Table 2, focusing on communication, dignity and respect, and the facility environment. Communication was assessed by asking women if they were informed about the results of procedures and tests, understood their purposes, received counseling on pregnancy complications, expectations, birth preparation, diet, and breastfeeding, and had the opportunity to ask questions. Dignity and respect were assessed by questions on perceptions of being treated with respect and friendliness, privacy and confidentiality during ANC visits. A question on cleanliness was used to assess the care environment. The response codes for the 18 items were summed to create an experience of care index with Cronbach's alpha of 0.86. The experience of care score ranged from zero to 42, with higher scores indicating better experience of ANC.

Service Provision

The service provision outcome measure included nine items that captured whether participants received the recommended ANC services (Table 3), such as height, weight, and blood pressure measurements, urine and blood testing, tetanus vaccinations, iron supplements, anthelmintics, and antimalarials. Adding the response codes for the nine items created a service provision index with a Cronbach alpha of 0.54. The summative score ranged from zero to 16, with higher scores indicating higher quality ANC service provision. Because ultrasound screening had a different distribution, it was assessed separately as a binary variable per WHO recommendations for all women to receive at least one ultrasound during ANC. (*WHO*, 2016).

Independent Variables

The primary independent variable in this analysis is the time of data collection, with options of baseline (before intervention) or end-line (after intervention). Based on previous research, we included other potential predictors of ANC, such as women's demographic characteristics, socioeconomic status (SES), health status, prior healthcare encounters, and facility and provider characteristics (Table 1).

Statistical Analysis

The distribution of demographic factors and individual items used for the ANC quality of care measures in the baseline and end-line samples (n = 586) was examined using descriptive statistics. We employed chi-square and Fisher's exact tests with a statistical significance cutoff of 0.05 to analyze the differences between baseline and end-line responses. Before generating the composite scores, we performed exploratory factor analysis and examined Cronbach's alpha values to assess the internal consistency of the ANC experience of care and service provision indices. In the bivariate analysis, we used linear regression to examine the associations between the predictors of ANC quality and the summative scores and logistic regression to examine the associations between several predictors and receiving an ultrasound. All of the variables in the bivariate analysis that were significantly associated with the outcome measures were then included in the multivariate models with robust standard errors to account for clustering. Lastly, we performed post-estimation tests to evaluate model fit, checked for collinearity, and excluded variables that did not improve the models. All analyses were performed using STATA 17 (Stata Corp LLC, College Station, TX, USA).

Results

A summary of sociodemographic characteristics of the baseline and end-line cohorts is shown in Table 1. There were some statistically significant differences in sample characteristics between the baseline and end-line groups. For instance, there were more women under 30 years of age at end-line (64%) than at baseline (54.1%), and there were more primiparous women at baseline (31%) than at end-line (18%). Women at the end-line were from wealthier households and had a greater level of education.

Table 1 Participant characteristics

Characteristic	Overall n = 586 n (%)	Baseline n = 266 n (%)	Endline n = 320 n (%)	P-value
Age				< 0.001[1]
15 to 19 years	61 (10.4)	12 (4.5)	49 (15.3)	
20 to 29 years	289 (49.3)	132 (49.6)	157 (49.1)	
30 to 48 years	236 (40.3)	122 (45.9)	114 (35.6)	
Current marital status				0.274[2]
Single	10 (1.7)	4 (1.5)	6 (1.9)	
Partnered/cohabiting	31 (5.3)	9 (3.4)	22 (6.9)	
Married	541 (92.3)	251 (94.4)	290 (90.6)	
Widowed/divorced/separated	4 (0.7)	2 (0.8)	2 (0.6)	
Number of births[a]				0.009[1]
1	143 (25.1)	46 (18.3)	97 (30.6)	
2	119 (20.9)	58 (23.0)	61 (19.2)	
3	103 (18.1)	48 (19.1)	55 (17.4)	
4 or more	204 (35.9)	100 (39.7)	104 (32.8)	
Highest education				0.003[2]
No school/not finished primary	377 (64.3)	191 (71.8)	186 (58.1)	
Primary	33 (5.6)	12 (4.5)	21 (6.56)	
Post-primary/vocational/secondary	160 (27.3)	60 (22.6)	100 (31.3)	
College or above	16 (2.7)	3 (1.1)	13 (4.1)	
Literacy: ability to read and write very well[a,b]	112 (21.8)	50 (20.0)	62 (23.5)	0.339[1]
Employed with income[a]†	43 (7.4)	29 (11.0)	14 (4.4)	0.002[2]
Self or household member work in health facility[a,b]	75 (12.8)	19 (7.2)	56 (17.5)	< 0.001[1]
Household wealth quintile[a]				0.004[2]
Poorest	148 (26.2)	73 (29.7)	75 (23.6)	
Poorer	177 (31.4)	71 (28.9)	106 (33.3)	
Middle	197 (34.9)	94 (38.2)	103 (32.4)	
Richer	33 (5.9)	7 (2.9)	26 (8.2)	
Richest	9 (1.6)	1 (0.4)	8 (2.5)	
Current occupation[a]				< 0.001[2]
Agriculture labor	175 (30.0)	116 (43.9)	59 (18.4)	
Casual labor	18 (3.1)	5 (1.9)	13 (4.1)	
Salaried worker	16 (2.7)	4 (1.5)	12 (3.8)	
Self-employed in petty trade/ small-scale industry	147 (25.2)	67 (25.4)	80 (25.0)	
Unemployed/homemaker/other	228 (39.0)	72 (27.3)	156 (48.8)	
Partner's occupation[a]				< 0.001[2]
Agricultural labor	315 (54.1)	180 (68.2)	135 (42.5)	
Casual labor	21 (3.6)	6 (2.3)	15 (4.7)	
Salaried worker	55 (9.5)	21 (8.0)	34 (10.7)	
Self-employed in petty trade/ small-scale industry	139 (23.9)	39 (14.8)	100 (31.5)	
Unemployed/homemaker/other	38 (6.5)	12 (4.6)	26 (8.2)	
No Partner	14 (2.4)	6 (2.3)	8 (2.5)	
Partner's education[a]				0.001[2]
No school/primary	384 (66.3)	198 (75.0)	186 (59.1)	
Post-primary/vocational/secondary	118 (20.4)	39 (14.8)	79 (25.1)	
College or above	59 (10.2)	20 (7.6)	39 (12.4)	
No partner	18 (3.1)	7 (2.7)	11 (3.5)	
Has health insurance[a,b]	567 (96.8)	253 (98.4)	314 (98.1)	0.516[2]
Tribe[a]				0.078[1]
Bimobas	49 (8.4)	31 (11.7)	18 (5.6)	

Table 1 (continued)

Characteristic	Overall n = 586 n (%)	Baseline n = 266 n (%)	Endline n = 320 n (%)	P-value
Busansi	41 (7.0)	14 (5.3)	27 (8.4)	
Konkomba	50 (8.5)	26 (9.8)	24 (7.5)	
Mampruli	312 (53.3)	137 (51.7)	175 (54.7)	
Moshi	46 (7.9)	20 (7.6)	26 (8.1)	
Other	87 (14.9)	37 (14.0)	50 (15.6)	
Religious affiliations[a]				0.041[2]
Catholic	12 (2.2)	8 (3.3)	4 (1.3)	
Protestant/pentecostal	22 (4.0)	15 (6.2)	7 (2.3)	
Other christian	49 (8.9)	20 (8.3)	29 (9.5)	
Muslim/other religion	465 (84.9)	198 (82.2)	267 (87.0)	
Had any pregnancy complications[a,b]	313 (53.6)	123 (46.2)	190 (59.4)	0.002[1]
Had severe pregnancy complications[b]	180 (57.5)	77 (29.0)	103 (32.2)	0.397[1]
Had complications in prior pregnancy[a,b]	159 (37.2)	61 (22.9)	98 (30.6)	0.037[1]
Received ANC in prior pregnancy[b]	413 (70.5)	193 (72.6)	220 (68.8)	0.315[1]
Prior facility delivery[b]	393 (67.1)	186 (69.9)	207 (64.7)	0.179[1]
Highest ANC facility[a]				0.106[1]
Gov't hospital	63 (11.7)	25 (11.0)	38 (12.1)	
Gov't HC/dispensary	249 (46.0)	94 (41.4)	155 (49.4)	
Mission/private facility	229 (42.3)	108 (47.6)	121 (38.5)	
Highest ANC provider type				<0.001[2]
Nurse/midwife	440 (75.1)	194 (72.9)	246 (76.9)	
Doctor/clinical officer	94 (16.0)	22 (8.3)	72 (22.5)	
Non-skilled attendant	52 (8.9)	50 (18.8)	2 (0.62)	
Reason for first ANC[a]				0.021[2]
Because of a problem	78 (13.4)	25 (9.5)	53 (16.7)	
Just for a checkup	500 (86.1)	237 (90.1)	263 82.7)	
Can't remember	3 (0.5)	1 (0.38)	2 (0.63)	
Timing of first antenatal visit[a]				0.646[2]
First trimester	413 (71.3)	191 (73.2)	222 (69.8)	
Second trimester	155 (26.8)	65 (24.9)	90 (28.3)	
Third trimester	11 (1.9)	5 (1.9)	6 (1.9)	
Number of antenatal visits[a]				0.048[1]
Less than 4	58 (9.9)	29 (11.0)	29 (9.1)	
4 or 5	156 (26.9)	82 (31.2)	74 (23.3)	
6 plus	367 (63.2)	152 (57.8)	215 (67.6)	
Postpartum length				<0.001[1]
Less than 4 weeks	285 (48.6)	158 (59.4)	127 (39.7)	
4 weeks or more	301 (51.4)	108 (40.6)	193 (60.3)	

[a]Missing data

[b]Binary variable ("Yes"/ "No" with "Yes" responses shown in table)

[1]Pearson chi-squared test

[2]Fisher's exact test

The average ANC experience of care score at the end-line was 24.5 ($SD = 8.3$) compared to the mean baseline score of 14.0 ($SD = 5.9$). Individual survey items reflected this (Table 2). In contrast to over 70% of women at baseline, fewer than half of the women at end-line reported never being informed of their results following weight and blood pressure measurements, as well as urine and blood tests. In addition, compared to baseline, more women at the end-line were informed about the warning signs of pregnancy complications and where to go in the event of complications.

Table 2 Quality of antenatal care variables

Experience of care	Overall n=586 n (%)	Baseline n=266 n (%)	Endline n=320 n (%)	P-value
Told the results after weighing				<0.001[2]
No, never	350 (61.2)	193 (75.7)	157 (49.5)	
Yes, a few times	73 (12.8)	41 (16.1)	32 (10.1)	
Yes, most of the time	46 (8.0)	16 (6.3)	30 (9.5)	
Yes, all the time	100 (17.5)	4 (1.6)	96 (30.3)	
Don't know or can't remember	3 (0.5)	1 (0.4)	2 (0.6)	
Told results after blood pressure measurements				<0.001[2]
No, never	309 (55.0)	180 (71.7)	129 (41.5)	
Yes, a few times	98 (17.4)	51 (20.3)	47 (15.1)	
Yes, most of the time	51 (9.1)	15 (6.0)	36 (11.6)	
Yes, all the time	104 (18.5)	5 (2.0)	99 (31.8)	
Told results after urine test				<0.001[2]
No, never	262 (55.9)	140 (75.7)	122 (43.0)	
Yes, a few times	146 (31.1)	42 (22.7)	104 (36.6)	
Yes, most of the time	28 (6.0)	2 (1.1)	26 (9.2)	
Yes, all the time	32 (6.8)	1 (0.5)	31 (10.9)	
Don't know or can't remember	1 (0.2)	0 (0.0)	1 (0.4)	
Told results after blood test				<0.001[2]
No, never	270 (55.1)	149 (72.7)	121 (42.5)	
Yes, a few times	138 (28.2)	51 (24.9)	87 (30.5)	
Yes, most of the time	36 (7.4)	3 (1.5)	33 (11.6)	
Yes, all the time	46 (9.4)	2 (1.0)	44 (15.4)	
Told about the signs of pregnancy complications[b]	356 (61.3)	146 (55.5)	210 (66.0)	0.001[1]
Told where to go in case of complications[b]	372 (64.0)	148 (56.3)	224 (70.4)	<0.001[1]
Told what to expect during pregnancy and delivery[b]	368 (63.3)	175 (66.5)	193 (60.7)	0.059[1]
Birth preparedness education[b]	497 (85.5)	223 (84.8)	274 (86.2)	0.564[1]
Nutrition education[b]	536 (92.3)	232 (88.2)	304 (95.6)	0.002[1]
Breastfeeding education[b]	518 (89.3)	227 (86.6)	291 (91.5)	0.087[1]
Understood purpose of tests performed				<0.001[2]
No, never	246 (42.4)	158 (60.3)	88 (27.7)	
Yes, a few times	121 (20.8)	61 (23.3)	60 (18.9)	
Yes, most of the time	89 (15.3)	38 (14.5)	51 (16.0)	
Yes, all the time	120 (20.7)	5 (1.9)	115 (36.2)	
Don't know or can't remember	4 (0.7)	0 (0.0)	4 (1.3)	
Understood purpose of medicines received				<0.001[2]
No, never	212 (36.6)	144 (55.0)	68 (21.4)	
Yes, a few times	137 (23.6)	77 (29.4)	60 (18.9)	
Yes, most of the time	104 (17.9)	37 (14.1)	67 (21.1)	
Yes, all the time	124 (21.3)	4 (1.5)	120 (37.7)	
Don't know or can't remember	3 (0.5)	0 (0.0)	3 (0.9)	
Felt able to ask any questions				<0.001[2]
No, never	173 (29.8)	113 (43.1)	60 (18.9)	
Yes, a few times	155 (26.7)	84 (32.1)	71 (22.3)	
Yes, most of the time	126 (21.7)	53 (20.2)	73 (23.0)	
Yes, all the time	121 (20.9)	12 (4.6)	109 (34.3)	
Don't know or can't remember	5 (0.9)	0 (0.0)	5 (1.6)	
Asked if she had any questions				<0.001[2]
No, never	225 (38.7)	146 (55.5)	79 (24.8)	
Yes, a few times	155 (26.7)	64 (24.3)	91 (28.6)	

Table 2 (continued)

Experience of care	Overall n = 586 n (%)	Baseline n = 266 n (%)	Endline n = 320 n (%)	*P-value*
Yes, most of the time	106 (18.2)	51 (19.4)	55 (17.3)	
Yes, all the time	92 (15.8)	2 (0.76)	90 (23.3)	
Don't know or can't remember	3 (0.5)	0 (0.0)	3 (0.9)	
Felt treated with respect				< 0.001[2]
No, never	54 (9.3)	45 (17.1)	9 (2.8)	
Yes, a few times	87 (15.0)	71 (27.0)	16 (5.0)	
Yes, most of the time	168 (28.9)	105 (39.9)	63 (19.8)	
Yes, all the time	271 (46.6)	42 (16.0)	229 (72.0)	
Don't know or can't remember	1 (0.2)	0 (0.0)	1 (0.3)	
Treated in friendly manner				< 0.001[2]
No, never	24 (4.4)	11 (4.9)	13 (4.1)	
Yes, a few times	107 (19.7)	80 (35.9)	27 (8.4)	
Yes, most of the time	185 (34.1)	114 (51.1)	71 (22.2)	
Yes, all the time	227 (41.8)	18 (8.1)	209 (65.3)	
Could discuss issues in private				< 0.001[2]
No, never	188 (32.4)	92 (35.1)	96 (30.2)	
Yes, a few times	132 (22.8)	67 (25.6)	65 (20.4)	
Yes, most of the time	115 (19.8)	63 (24.1)	52 (16.4)	
Yes, all the time	139 (24.0)	40 (15.3)	99 (31.1)	
Don't know or can't remember	6 (1.0)	0 (0.0)	6 (1.9)	
Felt the health facility was clean				< 0.001[2]
No, never	18 (3.1)	9 (3.4)	9 (2.8)	
Yes, a few times	56 (9.7)	41 (15.7)	15 (4.7)	
Yes, most of the time	141 (24.3)	99 (37.8)	42 (13.2)	
Yes, all the time	330 (56.9)	82 (31.3)	248 (78.0)	
Don't know or can't remember	35 (6.0)	31 (11.8)	4 (1.3)	

Total number of observations is 586. However, each variable in this table has < 586 due to missing data

[b]Binary variable ("Yes"/ "No" with "Yes" responses shown in table)

[1]Pearson chi-squared test

[2]Fisher's exact test

Similarly, a larger proportion of women at the end-line felt they could discuss their problems confidentially, ask their provider questions, and were encouraged to do so. At both baseline and end-line, most women stated that the health facility was clean and that they were treated with respect and friendliness.

The average ANC service provision score at the end-line was 11.5 (*SD* = 2.5) compared to 9.1 (*SD* = 2.3) at baseline (Table 3). In comparison to baseline, a higher proportion of women at end-line reported obtaining recommended ANC services most or all the time (e.g., height, weight, blood pressure measurements, urine, and blood tests, tetanus, iron supplementation, anthelmintics, and antimalarials). Eighty-eight percent of women received at least one ultrasound during ANC at end-line, compared to 44% at baseline.

Bivariate and Multivariate Results

Table 4 shows unadjusted models examining the relationship between the ANC quality measures and several predictors. The average improvement in the experience of care and service provision scores from the baseline to the end-line was 10.5 and 2.8 points, respectively, and the odds of receiving an ultrasound were 9.7 greater at the end-line compared to the baseline. Several other covariates were included in the multivariate models because they exhibited statistically significant associations with one or more of the ANC quality measures.

Table 5 shows the final multivariate models for the experience of care and service provision scores. The differences between baseline and end-line scores remained significant. After controlling for covariates, the mean experience of care score increased by nearly 10 points (Coeff = 10.3, 95% CI:

Table 3 Quality of prenatal care variables

Service provision	Overall n = 586 n (%)	Baseline n = 266 n (%)	Endline n = 320 n (%)	P-value
Height measured[b]	493 (84.1)	194 (74.3)	299 (94.0)	<0.001[2]
Weighed				<0.001[2]
No, never	6 (1.0)	6 (2.3)	0 (0.0)	
Yes, a few times	163 (27.8)	101 (38.7)	62 (19.5)	
Yes, most of the time	90 (15.4)	59 (22.6)	31 (9.8)	
Yes, all the time	319 (54.4)	95 (36.4)	224 (70.4)	
Don't know or can't remember	1 (0.2)	0 (0.0)	1 (0.3)	
Blood pressure taken				<0.001[2]
No, never	16 (2.7)	10 (3.8)	6 (1.9)	
Yes, a few times	163 (27.8)	104 (39.9)	59 (18.6)	
Yes, most of the time	106 (18.1)	63 (24.1)	43 (13.5)	
Yes, all the time	293 (50.0)	84 (32.2)	209 (65.7)	
Don't know or can't remember	1 (0.2)	0 (0.0)	1 (0.3)	
Did urine test				<0.001[2]
No, never	110 (18.8)	76 (28.9)	34 (10.7)	
Yes, a few times	365 (62.3)	169 (64.3)	196 (61.6)	
Yes, most of the time	34 (5.8)	9 (3.4)	25 (7.9)	
Yes, all the time	70 (11.9)	7 (2.7)	63 (19.8)	
Don't know or can't remember	2 (0.3)	2 (0.8)	0 (0.0)	
Did a blood test				<0.001[2]
No	88 (15.0)	55 (20.9)	33 (10.4)	
Yes, once	362 (61.8)	185 (70.3)	177 (55.7)	
Yes, more than once	128 (21.8)	20 (7.6)	108 (34.0)	
Don't know or can't remember	3 (0.5)	3 (1.1)	0 (0.0)	
Received a tetanus injection[b]	494 (84.3)	213 (81.0)	281 (88.4)	0.045[1]
Received Iron supplementation[b]	563 (96.1)	254 (96.6)	309 (97.2)	0.811[2]
Received Anthelminthics[b]	383 (65.4)	154 (58.6)	229 (72.0)	<0.001[1]
Received Antimalarials[b]	490 (83.6)	186 (71.0)	304 (95.6)	<0.001[1]
Received Ultrasound[b]	396 (68.3)	115 (43.9)	281 (88.4)	<0.001[1]

Note: Total number of observations is 586. However, each variable in this table has <586 due to missing data

[b]Binary variable ("Yes"/ "No" with "Yes" responses shown in table)

[1]Pearson chi-squared test

[2]Fisher's exact test

9.0,11.6), and the mean service provision score increased by about three points (Coeff = 2.6, 95% CI: 2.2, 3.05) from baseline to end-line. Women at end-line had significantly higher odds of receiving an ultrasound than women at baseline (OR: 24.1, 95%CI = 11.5, 50.3).

Parity, tribe, education, employment, partner occupation, number of antenatal visits, ANC facility type, and ANC provider type had statistically significant associations with experience of care scores. While tribe, occupation, partner occupation, number of antenatal visits, and ANC facility type had statistically significant associations with service provision scores. Additionally, women from wealthier households who received care at a government/mission/private hospital and had six or more ANC visits were more likely to have an ultrasound than poorer women who received care from health centers and had less than six ANC visits. Women who reported any pregnancy complications had higher ANC service provision scores but were no more likely to have ultrasound scans.

Discussion

This study aimed to assess whether an integrated, low-tech, high-fidelity obstetric emergency simulation training developed with PRONTO International for providers in

Table 4 Bivariate regressions of antenatal care quality measures on various predictors

	Linear regression: Coefficient [95%CI]						Logistic regression: OR [95%CI]		
	Experience score			Service provision score			Received an ultrasound		
Time period (ref—baseline)									
Endline	10.49***	[9.30	11.68]	2.83***	[2.44	3.22]	9.71***	[6.37	14.79]
Age (ref—20 to 29 years)									
15 to 19 years	1.20	[− 1.28	3.68]	0.62	[− 0.14	1.39]	1.50	[0.77	2.91]
30 to 48 years	− 0.58	[− 2.12	0.97]	− 0.39	[− 0.86	0.09]	0.73	[0.51	1.06]
Marital status (ref—married)									
Not married	1.07	[− 1.67	3.80]	0.17	[− 0.68	1.01]	1.00	[0.52	1.93]
Number of births (ref—4 or more)									
1	2.06*	[0.17	3.95]	0.75*	[0.16	1.33]	2.61***	[1.57	4.33]
2	− 0.68	[− 2.67	1.32]	0.26	[− 0.36	0.88]	1.45	[0.89	2.35]
3	0.08	[− 2.01	2.18]	0.47	[− 0.18	1.11]	1.22	[0.74	2.01]
Tribe (ref—Mampruli)									
Bimobas	− 0.71	[− 3.39	1.97]	− 0.09	[− 0.91	0.74]	0.46*	[0.25	0.85]
Busansi	− 1.33	[− 4.22	1.56]	0.61	[− 0.28	1.51]	1.33	[0.61	2.91]
Konkomba	− 5.03*	[− 7.68	− 2.37]	− 1.06*	[− 1.88	− 0.24]	0.26***	[0.14	0.48]
Moshi	− 2.24	[− 4.99	0.51]	− 0.46	[− 1.31	0.39]	0.62	[0.32	1.19]
Other	− 0.09	[− 2.20	2.02]	0.47	[− 0.18	1.12]	1.11	[0.64	1.91]
Religious affiliation (ref—muslim/other)									
Christian	− 1.58	[− 3.49	0.33]	− 0.64*	[− 1.23	− 0.05]	0.38***	[0.24	0.58]
Education (ref—no school)									
Primary	3.84*	[0.76	6.92]	0.88	[− 0.10	1.86]	2.26	[0.95	5.34]
Post-primary/vocational/secondary	4.15***	[2.55	5.75]	0.64*	[0.13	1.15]	2.06**	[1.34	3.16]
College or above	11.18***	[6.85	15.51]	2.20**	[0.83	3.58]	–	–	–
Literate: ability read and write well (ref—No)	2.12*	[0.31	3.93]	0.33	[− 0.24	0.90]	1.51	[0.95	2.40]
Employed with income (ref—No)	1.21	[− 1.57	4.00]	− 0.82	[− 1.67	0.04]	1.58	[0.76	3.28]
Household wealth quintile (ref—Poorest/Poorer)									
Middle	1.19	[− 0.38	2.76]	− 0.23	[− 0.71	0.26]	1.82**	[1.23	2.70]
Richer/richest	5.15***	[2.30	8.00]	0.91*	[0.03	1.80]	7.84**	[2.37	25.92]
Current occupation (ref—homemaker/unemployed/ other)									
Agricultural labor	0.97	[− 0.76	2.70]	− 0.47	[− 1.01	0.07]	0.49**	[0.32	0.75]
Casual labor	6.54*	[2.32	10.76]	1.09	[− 0.24	2.41]	2.67	[0.59	11.96]
Salaried worker	10.00***	[5.54	14.46]	1.13	[− 0.26	2.53]	5.00	[0.65	38.71]
Self-employed in petty trade/small-scale industry	1.49	[− 0.34	3.31]	− 0.27	[− 0.85	0.29]	0.56*	[0.36	0.87]
Partner's education (ref—no school/primary)									
Post-primary/vocational/secondary	2.39*	[0.58	4.21]	0.60*	[0.03	1.17]	2.05**	[1.26	3.32]
College or above	5.70***	[3.29	8.11]	0.87*	[0.12	1.62]	5.17***	[2.17	12.3]
No partner	− 0.25	[− 4.40	3.90]	− 0.05	[− 1.35	1.26]	0.59	[0.23	1.51]
Partner's occupation (ref—agricultural labor)									
Casual labor	0.22	[− 3.64	4.08]	− 0.58	[− 1.80	0.64]	0.69	[0.28	1.67]
Salaried worker	6.75***	[4.25	9.25]	0.92*	[0.13	1.71]	6.25***	[2.42	16.1]
Self-employed in petty trade/ small-scale industry	3.10**	[1.35	4.84]	0.52	[− 0.03	1.07]	2.35***	[1.47	3.75]
Unemployed/homemaker/Other	− 0.16	[− 3.10	2.78]	− 0.24	[− 1.17	0.68]	1.42	[0.67	2.99]
No partner	− 0.69	[− 5.36	3.99]	0.23	[− 1.24	1.71]	0.63	[0.21	1.83]
Self or family work in health facility (ref—No)	4.99***	[2.85	7.13]	1.13**	[0.47	1.80]	6.19***	[2.63	14.54]
Has health insurance (ref—No)	4.51	[− 1.03	10.05]	2.62**	[0.90	4.35]	1.75	[0.47	6.61]
Had any pregnancy complications (ref—No)	2.25**	[0.80	3.69]	0.86***	[0.42	1.31]	0.76	[0.53	1.08]

Table 4 (continued)

Time period (ref—baseline)	Linear regression: Coefficient [95%CI]						Logistic regression: OR [95%CI]		
	Experience score			Service provision score			Received an ultrasound		
Had severe pregnancy complications (ref—No)	0.94	[− 0.64	2.52]	0.67**	[0.19	1.16]	0.84	[0.57	1.21]
Had complications in prior pregnancy (ref—No)	0.98	[− 0.66	2.61]	0.06	[− 0.45	0.56]	0.65*	[0.45	0.96]
Received ANC in prior pregnancy (ref—No)	− 1.39	[− 2.98	0.20]	− 0.17	[− 0.66	0.33]	0.63*	[0.42	0.94]
Prior facility delivery (ref—No)	− 0.12	[− 1.67	1.43]	− 0.03	[− 0.51	0.44]	0.69	[0.47	1.01]
Reason for first ANC (ref—Just for a checkup)									
Because of a problem	0.71	[− 1.41	2.83]	− 0.29	[− 0.91	0.34]	1.28	[0.75	2.18]
Timing of first antenatal visit (ref—first trimester)									
Second trimester	− 0.35	[− 1.98	1.29]	− 0.21	[− 0.69	0.27]	1.07	[0.72	1.60]
Third Trimester	− 2.24	[− 7.54	3.07]	− 0.92	[− 2.47	0.64]	0.56	[0.17	1.87]
Number of antenatal visits (ref −≥ 6 visits)									
Less than 4	− 5.74***	[− 8.18	− 3.31]	− 3.07***	[− 3.79	− 2.34]	0.30***	[0.16	0.53]
4 or 5	− 2.44**	[− 4.09	0.79]	0.41	[− 0.90	0.08]	0.81	[0.54	1.21]
Highest ANC facility (ref—government HC/dispensary)									
Government hospital	0.35	[− 2.04	2.74]	1.30**	[0.55	2.05]	2.69**	[1.39	5.20]
Mission/private facility	− 2.65**	[− 4.20	− 1.09]	− 0.12	[− 0.60	− 0.37]	2.78***	[1.84	4.20]
Highest ANC provider type (ref—nurse/midwife)									
Doctor/clinical officer	− 0.30	[− 2.21	1.62]	0.49	[− 0.12	1.10]	3.25***	[1.72	6.16]
Non-skilled attendant	− 9.25**	[− 11.72	− 6.78]	− 1.49***	[− 2.27	− 0.70]	0.30***	[0.16	0.54]
Postpartum length less than 4 weeks (ref—≥ 4 weeks)	− 3.21***	[− 4.64	− 1.78]	− 0.83***	[− 1.28	− 0.39]	0.68*	[0.48	0.97]

95% confidence intervals in brackets.

*p < 0.05, **p < 0.01, ***p < 0.001

The mean of experience of care score was 19.7 (SD = 9.0) and range from 0 to 42. The mean of the service provision score was 10.6 (SD = 2.8) and range from 0 to 16

northern Ghana improved ANC quality. It also examined predictors of ANC quality at the patient, provider, and facility levels. Our findings indicate that the intervention enhanced ANC quality in both service provision and care experience domains.

There is a dearth of published research on the quality of ANC and even less on interventions to improve the quality of care. Most prior research focused on ANC uptake, including early ANC initiation and completion of four or more ANC visits (Cherniak et al., 2017; Kirkwood et al., 2013; Mangwi Ayiasi et al., 2016; Mbuagbaw et al., 2015; Waiswa et al., 2015). The limited research on the quality of ANC focused on service provision activities such as increased screening for warning signs (Manzi et al., 2018). A 2020 systematic review also found a significant gap in the literature on interventions to address ANC adherence in sub-Saharan Africa, urging additional research on ANC quality (Esopo et al., 2020).

Although ANC quality was not the primary outcome of the original intervention, it is not surprising that the intervention also improved ANC quality, given that the same providers deliver antenatal and intrapartum care in the setting.

An earlier analysis of the intervention's effect on the primary outcome of Person Centered Maternity Care (PCMC) found that this intervention improved the experience of care during the intrapartum period (Afulani, Aborigo, et al., 2019). The training, which emphasized both patient-provider and provider-provider interactions and provided opportunities to implement this through simulations of obstetric emergencies, likely improved overall provider behavior, resulting in the identified impact on both the quality of ANC and intrapartum care.

To our knowledge, this is the first study to assess whether an intervention such as an integrated simulation-based training designed to train health providers on respectful maternity care and management of obstetric and neonatal emergencies could potentially improve the quality of ANC. Few studies have examined factors associated with the quality of ANC, and this is one of the few studies in SSA that examine both service provision and experience of care. A prior study in Kenya, which informed the measures used in this study, revealed gaps in both service provision and experience of care (Afulani, Buback, et al., 2019a, 2019b). Similar to this study, that study identified

Table 5 Multivariate regressions of antenatal care quality measures on various predictors

| | Linear regression: Coefficient [95% CI] | | | | | | Logistic regression: OR [95% CI] | | |
	Experience score			Service provision score			Received an ultrasound		
Time period (ref—baseline)									
Endline	10.28***	[9.00		2.63***	[2.21	3.05]	24.08***	[11.53	50.32]
Age (ref—20 to 29 years)									
15 to 19 years	0.42	[− 1.96		0.22	[− 0.47	0.90]	–	–	–
30 to 48 years	− 0.36	[− 2.03		− 0.07	[− 0.46	0.33]	–	–	–
Number of births (Ref—4 or more)									
1	− 1.86	[− 4.25		–	–	–	1.88	[0.86	4.16]
2	− 1.65	[− 3.65		–	–	–	0.81	[0.37	1.76]
3	− 1.92*	[− 3.70		–	–	–	0.76	[0.35	1.65]
Tribe (ref—Mampruli)									
Bimobas	− 0.87	[− 2.81		− 0.37	[− 0.97	0.23]	0.35	[0.13	1.00]
Busansi	− 1.41	[− 3.54		0.42	[− 0.47	1.30]	0.67	[0.24	1.89]
Konkomba	− 5.92***	[− 8.04		− 1.29***	[− 1.95	− 0.64]	0.29**	[0.13	0.62]
Moshi	− 2.44*	[− 4.59		− 0.41	[− 1.22	0.40]	0.43	[0.17	1.06]
Other	− 0.57	[− 2.38		0.14	[− 0.38	0.66]	0.56	[0.19	1.70]
Education (ref—no school/primary)									
Post-primary/vocational/secondary	1.95*	[0.37		–	–	–	–	–	–
College or above	6.00**	[2.01		–	–	–	–	–	–
Household wealth (ref—poorest/poorer)									
Middle	–	–		− 0.36	[− 0.76	0.05]	2.60**	[1.29	5.24]
Richer/richest	–	–		− 0.28	[− 1.04	0.48]	5.73*	[1.15	28.58]
Current occupation (ref—unemployed/homemaker)									
Agricultural labor	5.04***	[3.60		0.49*	[0.00	0.99]	1.38	[0.65	2.92]
Casual labor	3.82*	[0.35		0.86	[− 0.00	1.72]	8.74*	[1.40	54.64]
Salaried worker	2.97	[− 0.97		0.34	[− 0.72	1.39]	2.22	[0.26	19.01]
Self-employed in petty trade/small-scale industry	2.98***	[1.40		0.25	[− 0.24	0.75]	1.20	[0.56	2.61]
Self or family work in health facility	0.74	[− 1.27		0.37	[− 0.15	0.89]	2.55	[0.71	9.16]
Partner's occupation (ref—agricultural labor)									
Casual labor	− 2.51	[− 5.32		− 1.43**	[− 2.41	− 0.44]	0.25*	[0.08	0.78]
Salaried worker	3.00*	[0.49		0.11	[− 0.50	0.72]	1.57	[0.49	5.08]
Self-employed in petty trade/ small-scale industry	0.76	[− 0.78		− 0.23	[− 0.71	0.26]	1.05	[0.48	2.27]
Unemployed/homemaker/other	− 0.73	[− 3.28		− 0.71	[− 1.59	0.16]	0.37	[0.09	1.59]
No partner	− 3.91**	[− 6.70		− 0.26	[− 1.24	0.72]	0.19**	[0.06	0.61]
Had any pregnancy complications	0.85	[− 0.33		0.38*	[0.01	0.75]	0.51*	[0.29	0.89]
Number of antenatal visits (ref—≥ 6 visits)									
Less than 4	− 4.28***	[− 6.54		− 3.14***	[− 4.28	− 2.37]	0.10***	[0.03	0.30]
4 or 5	− 0.42	[− 1.81		− 0.03	[− 0.44	0.39]	0.46*	[0.22	0.99]
Highest ANC facility (ref—government hc/dispensary)									
Government hospital	2.32*	[0.27		1.66***	[0.91	2.41]	4.53**	[0.91	5.04]
Mission/private facility	− 1.30	[− 2.72		− 0.03	[− 0.41	0.47]	7.24***	[3.06	17.12]
Highest ANC provider type (ref—nurse/midwife)									
Doctor/clinical officer	− 2.13*	[− 3.86		–	–	–	1.85	[0.73	4.70]
Non-skilled attendant	− 1.30	[− 2.72		–	–	–	1.14	[0.27	4.79]
Postpartum length > = 4 week (ref—≥ 4 weeks)	− 0.50	[− 1.67		− 0.14	[− 0.51	0.23]	–	–	–
Constant	14.08	[11.68		9.37	[8.68	10.06]	2.30	[1.11	4.74]
N	507			515			506		
R-squared	0.49			0.43					

95% confidence intervals in brackets *p < 0.05, **p < 0.01, ***p < 0.001

deficiencies in ANC quality, including significant gaps in communication and autonomy and routine ultrasound (Afulani, Buback, et al., 2019a, 2019b). Prior studies in Ghana have also noted gaps in the quality of ANC, with similar predictors highlighting disparities (Afulani, 2015; Amponsah-Tabi et al., 2022a; Atinga & Baku, 2013). In particular, ANC quality has been shown to be poorer in rural areas, among women of lower socioeconomic status, and among those who initiate ANC late, receive care less frequently, and use lower-level health facilities (Afulani, 2015; Amponsah-Tabi et al., 2022a; Atinga & Baku, 2013). Therefore, interventions to improve ANC need to address these disparities.

The study has some limitations described in the original study (Afulani, Aborigo, et al., 2019). The lack of a control group, which poses threats to internal validity such as history and maturation, and the inclusion of facilities from only one district, which limits generalizability, are two examples. Furthermore, due to workforce turnover, not all providers in the intervention sites were exposed to the full intervention, thereby underestimating the intervention's effects. Lastly, the data used in this study are now quite old. Nonetheless, this study makes an important contribution to the literature on interventions to improve the quality of ANC.

Our findings demonstrate the potential effectiveness of integrated low-tech simulation training approaches for improving ANC quality in both service provision and experience of care domains. The original study focused on the interventions' impact during the intrapartum period. This study shows the spillover effect on ANC, indicating the intervention's multiplicative effects. Considering the limited evidence on interventions to enhance care quality across the entire maternity continuum and the potentially higher costs and reduced efficiency of stage-specific interventions, these findings highlight the importance of prioritizing integrated approaches that target multiple outcomes throughout the continuum of care. Additional studies with rigorous designs in varied settings are needed to extend the evidence on such antenatal and intrapartum care interventions.

Declarations

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