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Decentralizing Maternity Services to Increase Skilled Attendance at Birth and Antenatal Care Utilization in Rural Rwanda: A Prospective Cohort Study

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Abstract

To evaluate the effectiveness of decentralizing ambulatory reproductive and intrapartum services to increase rates of antenatal care (ANC) utilization and skilled attendance at birth (SAB) in Rwanda. A prospective cohort study was implemented with one control and two intervention sites: decentralized ambulatory reproductive healthcare and decentralized intrapartum care. Multivariate logistic regression analysis was performed with primary outcome of lack of SAB and secondary outcome of ≥ 3 ANC visits. 536 women were entered in the study. Distance lived from delivery site significantly predicted SAB ($p = 0.007$), however distance lived to ANC site did not predict ≥ 3 ANC visits ($p = 0.81$). Neither decentralization of ambulatory reproductive healthcare ($p = 0.10$) nor intrapartum care ($p = 0.40$) was significantly associated with SAB. The control site had the greatest percentage of women receive ≥ 3 ANC visits ($p < 0.001$). Receiving < 3 ANC visits was associated with a 3.98 times greater odds of not having SAB ($p = 0.001$). No increase in adverse outcomes was found with decentralization of ambulatory reproductive health care or intrapartum care. The factors that predict utilization of physically accessible services in rural Africa are complex. Decentralization of services may be one strategy to increase rates of SAB and ANC utilization, but selection biases may have precluded accurate analysis. Efforts to increase ANC utilization may be a worthwhile investment to increase SAB.

Keywords

Global; Decentralization; Skilled birth attendance

Introduction

In 2013, sub-Saharan Africa had a maternal mortality ratio (MMR) of 510 per 100,000 live births, the highest in the world [1]. Compared to other countries in the region, Rwanda has seen a significant decline in MMR since 2005. Recent data shows an impressive 47 % decline compared to the 29 % decline seen in neighboring Uganda and 23 % in Burundi. Although below the average for sub-Saharan Africa, world-wide Rwanda comparatively has a high MMR of 320 and an adult lifetime risk of maternal death of 1 in 66 [1]. Due to the complexity of the problem, it has become clear that no universal solution and no single intervention in isolation will significantly reduce maternal mortality [2]. However, because most life-threatening obstetric emergencies cannot be predicted and occur during the peripartum period, focus has shifted to increasing access to skilled attendance at birth (SAB), defined as having a doctor, nurse or midwife competent in managing uncomplicated pregnancies, deliveries and postpartum issues present at the delivery and immediately postpartum in a setting with appropriate resources [3]. This comprehensive but targeted

intervention of SAB has been shown to be associated with reduced maternal mortality and is now advocated as the single most important peripartum factor in preventing maternal deaths [4].

While SAB is recognized as a successful strategy to reduce maternal mortality, many obstacles prevent women from accessing a skilled birth attendant in low and middle-income countries (LMIC). Challenging geography, lack of financial resources and insufficiently educated and/or trained personnel are some of the problems in LMIC public health systems that need solutions in order to achieve high access to SAB. Decentralization of services is one key approach that has been employed in several countries in an attempt to increase access to health services. In decentralized systems, local healthcare facilities and workers are allowed a degree of autonomy over financial and human resources and thus can tailor services and resources to their community's challenges and needs [5].

The Rwandan Ministry of Health utilizes a form of administrative decentralization in their public health infrastructure called deconcentration [6]. In this system, each level is accountable to the level above and ultimately to the Ministry of Health, who provides resources for services but allows some individualization of programs and service implementation lower in the pyramid of services. Rwanda has referral hospitals at the top of their pyramidal system, followed by district hospitals, and community health centers, which are currently the level of entry into the healthcare system for women in labor. Recognizing the geographic barrier to access, Rwanda most recently introduced health posts: smaller sites functioning under the authority of health centers, which provide basic ambulatory services, including focused antenatal care (ANC).

While it is difficult to ascertain the effectiveness of decentralization in many instances [5], some studies have shown improved ANC services [7] and maternal outcomes [8] after its implementation. No studies to date, however, have specifically evaluated the effect of decentralization on rates of ANC utilization and SAB. This study thus evaluated the effectiveness of decentralizing services at two levels, ambulatory reproductive health care services and intrapartum services, in increasing ANC utilization and SAB in a rural Rwandan community. We hypothesized that the decentralization of these services will increase rates of ANC utilization and SAB.

Materials and Methods

A prospective cohort study was implemented in the Western Province of Rwanda between September 2010 and September 2011, with two intervention health posts and one control health post. Currently, the health post is the lowest level of the healthcare infrastructure where women can receive ambulatory level reproductive healthcare services and the health center is the lowest level where women in labor receive care (intrapartum services). At one intervention health post, ambulatory care was thus further decentralized from the health post to the village level, with a mobile nurse providing in-home comprehensive reproductive health care. This nurse worked closely with the community health workers to organize this village-level health care service. At least one or two of these community workers, who live and work in every village in Rwanda, are responsible for assisting all pregnant women in

attending their prenatal care appointments and accompanying them to a health care facility at the time of labor.

At the second intervention health post, intrapartum care was further decentralized from the local health center to the level of the health post. This was accomplished by the opening of a maternity center where women in labor could deliver their babies. This center was staffed by trained nurses and referral services were established to the district hospital for high risk cases. No changes to services were made at the control site for the study.

Convenience sampling of all pregnant women living in the catchment areas of the three health posts was performed. Women receiving ANC at any of these sites were eligible for inclusion. At the control site and the decentralized intrapartum site, all women presenting for ANC were individually educated about the study and recruited to participate. A study nurse consented the women who agreed to participate in the study. At the decentralized ambulatory care site, women willing to participate received group education in the villages by the mobile nurse followed by individual written informed consent. After delivery, data were abstracted from the existing ANC charts, partographs, and intrapartum charts.

The primary outcome of interest was lack of SAB. Secondary outcome was having at least three ANC visits. SAB was defined as receiving intrapartum and postpartum care by a nurse, midwife, or physician at a health center, district hospital, or at the study health post with decentralized intrapartum care. Data on the following maternal and neonatal outcomes were also gathered: intra-partum hemorrhage, post-partum hemorrhage, obstetric fistulae, intrapartum or postpartum fever, retained placenta, eclampsia, hysterectomy, maternal death, admission to the neonatal intensive care unit, perinatal death, neonatal sepsis.

Two distance variables were defined. Village-delivery site distance was defined as the average number of minutes it takes to walk from village to delivery site. Village-ANC site distance was defined as the average number of minutes it takes to walk from village to ANC site.

Associations of socio-demographic and distance variables with the two outcomes were evaluated using Chi-square and ANOVA tests for categorical and continuous variables, respectively. Number of ANC visits was dichotomized at the median to greater than or equal to three visits. Chi-square was used to evaluate bivariate associations between the above defined outcome variables and intervention site. A Chi-square test was also done to evaluate the association between number of ANC visits and having no SAB. Adverse outcomes were dichotomized and bivariate tests were done to evaluate for associations with the outcome variables of interest and intervention site.

Backward stepwise multivariate logistic regression analysis was performed for predicting the factors associated with the two outcomes of interest. Simultaneous evaluation for confounding was done to create an appropriately adjusted model that best fit the data. Statistical analyses were done using STATA software, version 11 (College Station, TX: StataCorp, LP). Two-sided tests were used, with statistical significance defined as having $p < 0.05$.

The Rwandan National Ethics Committee and the Institutional Review Board at Albert Einstein College of Medicine/Montefiore Medical Center approved this study.

Results

During the study period, 411 women were eligible for enrollment from the control health post, of whom 125 (30 %) chose to participate. Three hundred and forty-nine women were eligible at the health post with decentralized ambulatory care, with 183 (52 %) enrolling. At the third health post, with decentralized intrapartum care, 519 women were eligible and 241 (46 %) enrolled. Thirteen women (2.4 %) were lost to follow-up and thus a total of 536 pregnant women completed the study. Twenty-three percent of participants were from the control site, 33 % from the site of decentralized ambulatory care, and 44 % from the site of decentralized intrapartum care.

No differences were found amongst the participants at the three sites in age, parity, number of live children, marital status, prior cesarean section, or prior stillbirth (Table 1). Baseline socioeconomic data on occupation and level of education also showed this study population to be very homogenous. A difference was found in the village-delivery site ($p < 0.001$) and in the village-ANC site distances ($p < 0.001$). The site of decentralized ambulatory care had the greatest village-delivery site distance: 98.1 [standard deviation (SD) 34.8] min versus 64.9 (27.6) and 52.9 (23.4) min at the decentralized intrapartum care and control sites, respectively. The site of decentralized intrapartum care had the greatest village-ANC site distance: 84.5 (31.3) min compared to 36.9 (18.6) and 54.2 (38.0) in the decentralized ambulatory care and control sites, respectively.

Rates of SAB at the three study sites were greater than 90 %, with no difference found among them (Table 2). Analysis of bivariate associations (Table 3) found that greater village-delivery site distance ($p = 0.03$) was associated with not having SAB. When further evaluated by multivariate logistic regression, this distance was found to be a predictor of SAB (Table 4) with every 30-min increase in travel time on foot being associated with an 83 % increased adjusted odds [adjusted Odds Ratio (aOR) = 1.83, 95 % CI: 1.78–83; $p = 0.007$] of not having a SAB. Having < 3 ANC visits was also associated with not having SAB ($p = 0.001$; Table 3), with a nearly threefold greater adjusted odds of not having a SAB (Table 4) if the participant received < 3 ANC visits during her pregnancy (aOR = 3.98, 95 % CI: 1.73–9.18; $p = 0.001$). Neither decentralization of ambulatory care (aOR = 0.32, 95 % CI: 0.08–1.24; $p = 0.10$) nor intrapartum care (aOR = 0.63; 95 % CI: 0.22–1.81; $p = 0.39$) was independently associated with rates of SAB.

A difference was found between the sites in the percentage of women receiving at least 3 ANC visits during their pregnancy ($p < 0.001$; Table 2). The control site had the greatest percentage of women receive at least 3 ANC visits (79 %) compared to the site of decentralized ambulatory care (75 %) and the site with decentralized intrapartum care (56 %). In multivariate logistic regression analysis (Table 5) the site providing decentralized intrapartum care was independently associated with a 67 % reduced odds of having 3 ANC visits (aOR = 0.33, 95 % CI: 0.19–0.56; $p < 0.001$) compared to the control group.

Village-ANC site distance was greater among the women receiving <3 ANC visits [67.4 (35.8) min vs. 58.8 (36.2), $p = 0.01$] (Table 6) but was not an independent predictor of having at least 3 ANC visits ($p = 0.81$; Table 5). Having <3 ANC visits was associated with not having SAB [17 (63.0 %) vs. 10 (37.0 %) not having SAB in women with <3 compared to ≥3 ANC visits respectively, $p = 0.001$] (Table 3).

Adverse outcomes were the same at each intervention sites (Table 2) and was found to have no association with either SAB (Table 3) or ANC visits (Table 6).

Discussion

Although decentralized intrapartum care in our study did not result in a significant increase in SAB, we did find that living farther from the delivery site was associated with increased odds of not having SAB. Similar results were found in a study conducted in rural Zambia, where a two-fold greater distance to delivery site was associated with a 29 % lower odds of a woman having a SAB (95 % CI: 14–40 %) [9]. Importantly, decentralizing intrapartum care to a lower level of the healthcare infrastructure did not result in increases in adverse maternal or neonatal outcomes.

Decentralizing ambulatory reproductive healthcare resulted in decreasing the geographic obstacle; however, it did not result in increased rates of ANC utilization and village-ANC distance was not found to be a significant predictor of having at least 3 ANC visits. A large systematic review has shown that determinants of ANC utilization are complex and multifactorial. They vary not only by region of the world but also by and within religions, ethnicities, and social circles [10]. It is possible that there are other unmeasured determinants of ANC utilization affecting women in this region of rural Rwanda that may explain why distance was not associated with ANC utilization.

Rates of SAB were high at all health posts, over 90 %, and much higher than the national rate of 69 %. It was also much higher than the rate in the Western Province, 71 %, where our study was conducted [11]. With such a high rate, variability between the sites was low and likely contributed to the lack of significant differences in SAB. The most plausible explanation for these high rates is the extensive efforts by local officials to increase SAB. These new efforts included community health worker education and mobilization, provision of traditional ambulances to each village, and provision of clean newborn clothes/blankets at the time of delivery. Financial disincentives to home delivery have also been instituted as a way to achieve increase attended deliveries in health care facilities. While not a national policy, some health sectors, including the one in which this study took place, have charged the woman 3000Frw and the traditional birth attendant 7000Frw if it was confirmed that the woman delivered at home, which totals approximately 15USD.

In this study, we found that neither the decentralization of intrapartum services nor ambulatory reproductive healthcare services was associated with increased SAB. Given the fact that there was no available baseline data for the study population allowing a pre/post evaluation of the interventions, it is possible that there were in fact increases in SAB that this prospective study was not able to detect. While women at the site of decentralized

intrapartum care were 37 % less likely to not have a SAB, this was not significant. It is also possible we did not have enough power to show a real difference in SAB. We did, however, find that decentralized intrapartum care was independently associated with a reduced odds of having at least 3 ANC visits. This unexpected finding may be attributed to low enrollment in our control group.

When we compared rates of SAB at the health post with decentralized intrapartum care to the control group, we did not find a significant difference. This may represent confounding by distance from the delivery site: true differences in SAB at these two sites may have been obscured by the fact that the control population lived closer to the site of delivery than did the population at the health post with decentralized intrapartum care, instead of being at similar distances prior to decentralization. In addition, enrollment was overall lower at the control site. This population may have characteristics that resulted in their being more receptive to new services compared to other people. This likely attenuated any measurable differences in SAB between study sites, if they existed.

An additional explanation may be the high rates of ANC utilization in our study population. Nationally in Rwanda, only approximately 58 % of women receive 2–3 ANC visits during their pregnancy [11]. In our study, rates of having at least 3 ANC visits ranged between 56 and 79 %. In addition, our research revealed a nearly fourfold increased odds of having an unattended delivery among women who did not receive at least 3 ANC visits. Taken together, these findings add to the existing body of evidence supporting a positive association between ANC utilization and SAB [12, 13] and emphasize the potential benefit from investment in ANC services.

The fact that village-ANC distance was not a predictor of having at least 3 ANC visits while village-delivery site distance was a significant predictor of SAB suggests complexity in access to care in these settings. Studies in Tanzania have concluded that fear of hospital, fear of death, and a perceived association of hospitals with delivery complications, are important factors determining utilization in addition to cost and distance [14, 15]. In Rwanda, for example, if a woman does not receive all of the WHO recommended 4 prenatal care visits, she will have to pay the equivalent of \$4–\$52 for her delivery, depending on the services rendered. This cost can be prohibitively expensive in a rural subsistence farming community. It is therefore clear that access to and utilization of care are not always directly related and that multiple factors exist that affect utilization aside from physical access or distance to a service.

Our study was limited chiefly by our control site enrollment. As described above, the distances from the sites of delivery and ANC were not similar among the three sites. Selection bias also played a role in that women who did not initiate ANC services during their pregnancies were not included in the study. It is likely that this vulnerable population had lower rates of SAB.

Efforts to decrease maternal mortality require improved access to and utilization of intrapartum care by skilled birth attendants. Further research needs to be done that specifically assesses the vulnerable population of women who do not receive any care

during their pregnancy or delivery. Additional research is also necessary not only to further our understanding of the determinants of ANC utilization and rates of unattended delivery, but also to elucidate the barriers to utilization of physically accessible services.

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Table 1

Demographic and clinical characteristics at study enrollment

Characteristic	Control (n = 124)	Decentralized ambulatory care (n = 179)	Decentralized intrapartum care (n = 233)	p value
Age (years)	28.8 (6.3)	27.8 (5.7)	28.1 (5.7)	0.36
<i>Parity</i>				
0	30 (26.6)	52 (29.4)	63 (27.4)	0.62
1	24 (21.2)	34 (19.2)	50 (21.7)	
2	22 (19.5)	39 (22.0)	38 (16.5)	
3	10 (8.9)	24 (13.6)	29 (12.6)	
4+	27 (23.9)	28 (15.8)	50 (21.7)	
<i>Number of live children</i>				
0	31 (27.4)	55 (31.1)	70 (30.4)	0.91
1	25 (22.1)	34 (19.2)	45 (19.6)	
2	21 (18.6)	41 (23.2)	42 (18.3)	
3	14 (12.4)	21 (11.8)	29 (12.5)	
4+	22 (19.5)	26 (14.7)	44 (19.1)	
<i>Marital status</i>				
Married	108 (97.3)	155 (95.7)	209 (97.2)	
Single or divorced	3 (2.7)	7 (4.3)	6 (2.8)	0.66
<i>Prior cesarean section</i>				
No	106 (93.8)	167 (94.9)	224 (97.4)	0.23
Yes	7 (6.2)	9 (5.1)	6 (2.6)	
<i>Prior stillbirth</i>				
No	110 (97.4)	162 (92.1)	222 (96.5)	0.05
Yes	3 (2.7)	14 (8.0)	8 (3.5)	
Village-delivery distance (min)	52.9 (23.4)	98.1 (34.8)	64.9 (27.6)	<0.001
Village-ANC ^a distance (min)	54.2 (38.0)	36.9 (18.6)	84.5 (31.3)	<0.001

All values are mean (SD) or frequency (%)

^a ANC antenatal care

Table 2

Bivariate analysis of skilled attendance at birth, at least 3 antenatal care (ANC) visits, and adverse outcomes by site of care

	Control (n = 124)	Decentralized ambulatory care (n = 179)	Decentralized intrapartum care (n = 233)	<i>p</i> value
<i>Skilled attendance at birth</i>				
No	6 (4.8)	8 (4.5)	13 (5.6)	0.87
Yes	118 (95.2)	171 (95.5)	220 (94.4)	
<i>3 ANC visits</i>				
No	26 (21.0)	44 (24.6)	103 (44.2)	<0.001
Yes	98 (79.0)	135 (75.4)	130 (55.8)	
Adverse outcomes	5 (4 %)	14 (8 %)	18 (8 %)	0.36

All values are n (%)

Table 3

Bivariate associations of demographic and clinical characteristics with skilled attendance at birth

	No skilled attendance at birth (n = 27)	Skilled attendance at birth (n = 509)	p value
Age (years)	28.6 (5.86)	28.1 (5.83)	0.68
<i>Parity</i>			
0	4 (14.8)	141 (28.6)	
1	5 (18.5)	103 (20.9)	
2	8 (29.6)	91 (18.5)	0.45
3	4 (14.8)	59 (12.0)	
4+	6 (22.2)	99 (20.0)	
<i>Number of live children</i>			
0	4 (14.8)	152 (30.8)	
1	5 (18.5)	99 (20.1)	
2	9 (33.3)	95 (19.3)	0.28
3	3 (11.1)	61 (12.4)	
4+	6 (22.2)	86 (17.4)	
<i>Marital status</i>			
Married	27 (100.0)	445 (96.5)	0.33
Single or divorced	0	16 (3.47)	
<i>Prior cesarean section</i>			
No	26 (96.3)	471 (95.7)	0.89
Yes	1 (3.70)	21 (4.27)	
<i>Prior stillbirth</i>			
No	25 (92.6)	469 (95.3)	0.52
Yes	2 (7.41)	23 (4.67)	
Village-delivery distance (min)	87.2 (30.6)	72.4 (34.6)	0.03
Village-ANC distance (min)	70.9 (42.8)	61.1 (35.9)	0.17
<i><3 ANC visits</i>			
No	17 (63.0)	156 (30.7)	0.001
Yes	10 (37.0)	353 (69.4)	
Adverse outcome	0	37 (7 %)	0.15

All values are n (%)

Table 4

Multivariate associations of demographic and clinical characteristics with skilled attendance at birth

	Odds ratio	95 % CI	<i>p</i> value
Village-delivery distance (per 30 min increment)	1.83	1.78–2.83	0.007
<3 ANC visits	3.98	1.73–9.18	0.001
Site			
Control	Reference	Reference	Reference
Decentralized intrapartum care	0.63	0.22–1.81	0.39
Decentralized ambulatory care	0.32	0.08–1.24	0.10

Table 5

Multivariate associations of demographic and clinical characteristics with antenatal care (ANC) visits

	Odds ratio	95 % CI	p value
Village-ANC distance (per 30 min increment)	1.02	0.85–1.24	0.81
Site			
Control	Reference	Reference	Reference
Decentralized intrapartum care	0.33	0.19–0.56	0.0001
Decentralized ambulatory care	0.82	0.47–1.43	0.49

Table 6

Bivariate associations of demographic and clinical characteristics with 3 antenatal care (ANC) visits

	<3 ANC visits (n = 173)	3 ANC visits (n = 363)	p value
Age (years)	28.6 (6.17)	28.0 (5.65)	0.27
<i>Parity</i>			
0	39 (24.8)	106 (29.2)	
1	32 (20.4)	76 (20.9)	
2	33 (21.0)	66 (18.2)	0.24
3	14 (8.92)	49 (13.5)	
4+	39 (24.8)	66 (18.2)	
<i>Number of live children</i>			
0	43 (27.4)	113 (31.1)	
1	30 (19.1)	74 (20.4)	
2	35 (22.3)	69 (19.0)	0.33
3	15 (9.55)	49 (13.5)	
4+	34 (21.7)	58 (16.0)	
<i>Marital status</i>			
Married	145 (97.3)	327 (96.5)	0.63
Single or divorced	4 (2.68)	12 (3.54)	
<i>Prior cesarean section</i>			
No	150 (96.2)	347 (96.5)	0.77
Yes	6 (3.85)	16 (4.41)	
<i>Prior stillbirth</i>			
No	148 (94.9)	346 (95.3)	0.83
Yes	8 (5.13)	17 (4.68)	
Village-delivery distance (min)	72.5 (32.3)	73.5 (35.6)	0.76
Village-ANC distance (min)	67.4 (35.8)	58.8 (36.2)	0.01
Adverse outcome	13 (8 %)	24 (7 %)	0.70

All values are n (%)