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Knowledgeable antenatal care as a pathway to skilled delivery: modelling the interactions between use of services and knowledge in Zambia

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The link between antenatal care (ANC) and facility delivery is a specific example of the effect of early medical contacts on later use of essential services. The role of ANC in improving maternal health remains unclear. High levels of ANC are reported in a number of countries where skilled delivery remains uncommon. ANC may influence the use of services by increasing willingness to use services and educating about maternal health. The objective of this study is to understand the interaction between use of skilled and unskilled ANC, knowledge of obstetric complications and danger signs, and the eventual use of a facility for delivery. The study makes use of data from a survey of around 1700 women who had recently given birth across 11 districts of Zambia in 2011. Multivariate analysis is used to explore the associations between ANC use, knowledge and place of delivery. The results suggest that place of care and number of visits is strongly associated with the eventual use of a facility for delivery; an effect that is stronger in remote areas. Both skilled and unskilled ANC and obstetric knowledge is linked to higher use of facility delivery care while care provided at home appears to have an opposite effect. The research suggests that ANC influences later use of delivery care in two ways: by developing a habit to use formal care services and in increasing maternal knowledge. The work might be generalized to other health seeking behaviour to explore how the quantity and quality of initial contacts influence later use of services.

Keywords Maternal mortality, skilled delivery antenatal care, obstetric danger signs

KEY MESSAGES

- Antenatal care by both skilled and unskilled providers influences delivery seeking behaviour.
- Antenatal care may have a role in developing a habit to access skilled delivery care and in improving obstetric knowledge.
- Feedback between the effect of obstetric knowledge and use of antenatal care magnifies the effect of antenatal care.
- Maternal care offers a specific example of the more general link between routine use of health services and later access to essential care.

Introduction

While changing health care seeking behaviour is an important policy concern in most countries, health care habits seem particularly difficult to change in countries with poor health indicators. Improving knowledge about what influences health behaviours is, therefore, of significant concern to both policy makers and researchers. The objective of this study is to begin to understand the role of routine contacts with health practitioners in influencing later use of essential services. We focus on the specific example of maternal care and the link between skilled and unskilled antenatal care (ANC), knowledge of obstetric complications and danger signs and the eventual use of a facility for delivery. We attempt to answer the question 'does use of ANC, particularly skilled care, make it more likely that a woman will subsequently deliver at a facility with a skilled health worker?'.

The link between use of ANC and facility-based delivery care is a specific example of the chain of decision making that links initial contact with health practitioners to later use of essential services. The focus of this study was the extent to which ANC care is associated with skilled delivery services in Zambia. The study considers the association between the type and number of antenatal visits and examines the relationship between a woman's obstetric knowledge and ANC services. The role of ANC in improving maternal health remains unclear. While there is evidence that ANC can have a positive influence on the health of the child, through e.g. micro-nutritional supplements and maternal vaccinations, there is less evidence for its effect on the mother. Identifying maternal risk factors during pregnancy is generally not accurate leading to missed emergencies and potential danger to the life of the woman and newborn. ANC may, however, influence the uptake of delivery with a skilled birth attendant and at a facility, by encouraging a habit to utilize facility-based care and by improving maternal knowledge of obstetric danger signs.

Maternal health indicators have stagnated in Zambia over the past 20 years. The most recent Demographic and Health Survey for 2007 suggests the proportion of women with a delivery in a health facility has hardly changed over a decade; there was even a slight reduction in the early 1990s (Central Statistical Office *et al*. 2009). Considerable efforts are now underway to improve access to obstetric care. One such initiative is a UKAid funded programme, Mobilizing Access to Maternal Health Services in Zambia (MAMaZ), which seeks to increase demand for maternal health services in six districts. A series of demand-side interventions are being implemented as part of MAMaZ including community-based emergency transport, efforts to improve knowledge of obstetric care (through Safer Motherhood Groups or SMAGs) and community support systems such as savings schemes. Prior to implementing the intervention, a baseline survey was conducted in the intervention and comparison districts covered by the project. The survey data collected at baseline provide an opportunity to examine the linkages between knowledge, education and the use of services and likely pathways for improving service demand by individuals.

The article is structured as follows: in the next section the evidence on the interactions between individual knowledge, education and maternal service use is discussed; in the Methods section the data and methods are described while results are discussed in the Results section; potential policy implications for interventions are discussed in the Discussion section.

Modelling the interactions between knowledge and maternal service use

It is accepted that encouraging an increase in the use of obstetric and other essential medical services requires improvements both in quality and in availability of affordable medical care and stimulation of demand to mitigate barriers faced before a patient reaches a facility (Ensor and Cooper 2004). A cluster of demand side factors has been shown to be important in influencing health service use. For maternal health, the impact of a woman's obstetric knowledge and distance are strongly associated with use of skilled birthing services (Gabrysch *et al*. 2011a,b).

A consistent and substantial impact of education on maternal and child health seeking behaviour is a persistent theme in the literature in countries as varied as Thailand, Bangladesh and Peru (Chowdhury *et al*. 2007; Elo 1992; Raghupathy 1996). Part of the effect of education on demand is the general socialization and empowerment provided through education but at least one study (Morocco) suggests that the knowledge imparted through schooling can be directly attributed to improvements in (child) health status (Prevention of Maternal Mortality Network 1995).

Specific obstetric knowledge is directly associated with an increase in the use of facility-based delivery and general birth preparedness in countries such as Tanzania, Uganda and Zambia (Kabakyenga *et al*. 2011; Mpembeni *et al*. 2007; Smith *et al*. 2001). Improved obstetric knowledge may be imparted through ANC by increasing knowledge of danger signs (Pakistan), birth preparedness (Nepal) and increasing use of bed-nets (Kenya) (Mullany *et al*. 2007; Powell-Jackson and Hanson 2012; van Eijk *et al*. 2005). At the same time attendance for ANC and indeed other reproductive services such as family planning is likely to be in turn associated with higher levels of obstetric knowledge. In Karachi, women receiving ANC were shown to be more knowledgeable about ways of avoiding pregnancy-related complications such as anaemia (Nisar and White 2003).

The literature suggests a series of interactions between place of delivery, knowledge and use of ANC (Figure 1). ANC may affect the demand for delivery into two ways: a direct effect in indicating to women where they should seek delivery care, and an indirect effect by improving obstetric knowledge and thence health care seeking behaviour. These interactions suggest the possibility of a feedback effect since obstetric knowledge may in itself affect demand for antenatal as well as for skilled delivery care.

Methods

The analysis made use of a baseline study conducted as part of MAMaZ between December 2010 and May 2011 undertaken across six intervention and five comparison districts. The Zambian Ministry of Health determined selection of the intervention districts non-randomly by selecting districts with poor maternal health indicators that have no substantial

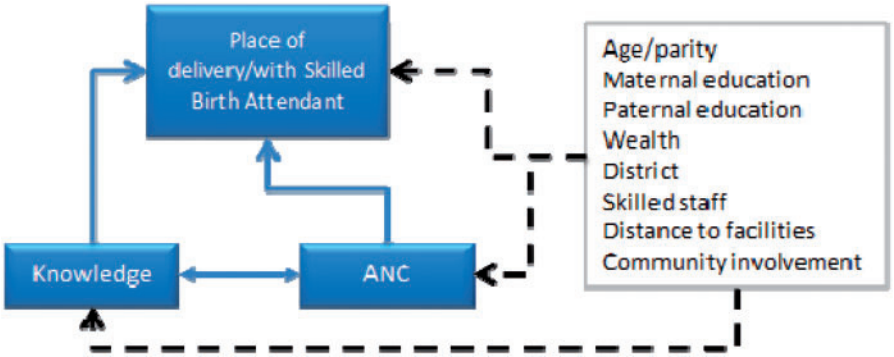

Figure 1 Associations between knowledge and use of delivery and ANC.

support from other donors. Intervention areas cover on average two health centres capable of providing basic essential obstetric care (BEOC) and the surrounding catchment area in each district. Catchment areas were defined in terms of the BEOC to which local health centres or posts were most likely to refer. Comparison districts were selected to match these areas that had similar maternal indicators (see Table 1). A sample of 3400 women, 1770 from the intervention and 1630 from the comparison districts, who had given birth in the preceding 3 months was selected. The sample was based on the need to measure a change of 10% or more in facility delivery with a skilled health worker before and after the intervention. Lists of all births in the 3 months prior to the survey in each area were constructed from lists provided by SMAGs from which the sample was drawn randomly. Information was not available on the distance of the community to the BEOC for all the baseline survey. A sub-sample that contains distance information of 1700 women was used for the analysis presented in this article. A questionnaire was administered, which was divided into five parts: attitudes towards maternal health including a woman's knowledge of danger signs, social norms and community attitudes, practices of ANC and delivery care, neonatal and post-natal care and household characteristics. The questionnaire was pre-tested in an area separate to the intervention. Data were double entered and frequency distributions were analysed for outliers and obvious discrepancies in data entry. Ethical approval for the study was obtained from ERES Converge Institutional Review Board of the University of Zambia.

Two modelling processes were undertaken. First, the association between facility attendance, knowledge, ANC and other factors were analysed using mixed effects logit models. The dependent variable of interest was the decision to seek delivery at a facility. Similar results for delivery with a skilled practitioner were derived and are available from the authors.

The facility model was specified as a mixed effects logit model as follows for household i in district j:

$$D_{ij}^{*} = A_{ij}\beta_1 + K_{ij}\beta_2 + X_{ij}\beta_3 + Z_{ij}v_j + u_{ij}\ facilityatt_{ij} = 1\ if\ D_{ij}^{*} > 0,$$
$$facilityatt_{ij} = 0\ if\ D_{ij}^{*} \leq 0,$$

where D_{ij}^{*} is a latent variable describing demand for place of delivery and *facilityatt* is a bivariate variable that takes the value of 1 when a woman opts for a facility delivery and zero otherwise; A_{ij} describe access to ANC; K_{ij} is the knowledge of maternal care; and X_{ij} are individual, household and community factors that influence access to care.

Table 1 Characteristics of the women in the baseline survey and sub-sample used in the analysis

	Comparison areas	Intervention areas	All	Sample used for analysis
Number of ANC visits	3.7	3.7	3.7	3.7
Delivery in a facility	48%	49%	49%	47%
Age	26.1	26.7	26.4	26.6
Parity	3.5	3.9	3.8	3.9
Highest education				
Some primary	46%	48%	47%	48%
Completed primary	15%	13%	14%	13%
Some secondary	21%	17%	19%	17%
Completed secondary or higher	3%	2%	2%	2%
Socio-economic groups				
Quintile 1	14%	25%	20%	23%
Quintile 2	18%	23%	20%	22%
Quintile 3	18%	21%	20%	20%
Quintile 4	22%	18%	20%	18%
Quintile 5	28%	13%	20%	16%

Fixed effects at the individual and household levels were assumed to be parity, age, education and wealth. The model allows for random constant effects at the district level as well as the number of skilled birth attendants per 1000 population in the district as proxy for the effect of different levels of service provision.

ANC is almost universal in Zambia but the number of visits and place of service varies considerably. World Health Organisation (WHO) recommends four visits to a skilled provider during pregnancy. In our sample, 47% received four or more visits with a skilled provider at a facility. A series of variables were defined to describe the characteristics of ANC received as follows: (1) the number of visits; (2) type of ANC (no care, home care, unskilled care with fewer than four visits, unskilled with four visits or more, skilled with fewer than four visits, skilled with four visits or more); (3) two bivariate variables used in the system modelling, with and without skilled ANC (more than four visits) and with and without unskilled ANC (more than four visits). Skilled antenatal ANC refers to care that is provided by a doctor, nurse, midwife or clinical officer while unskilled ANC refers to a contact with a traditional birth attendant or other worker.

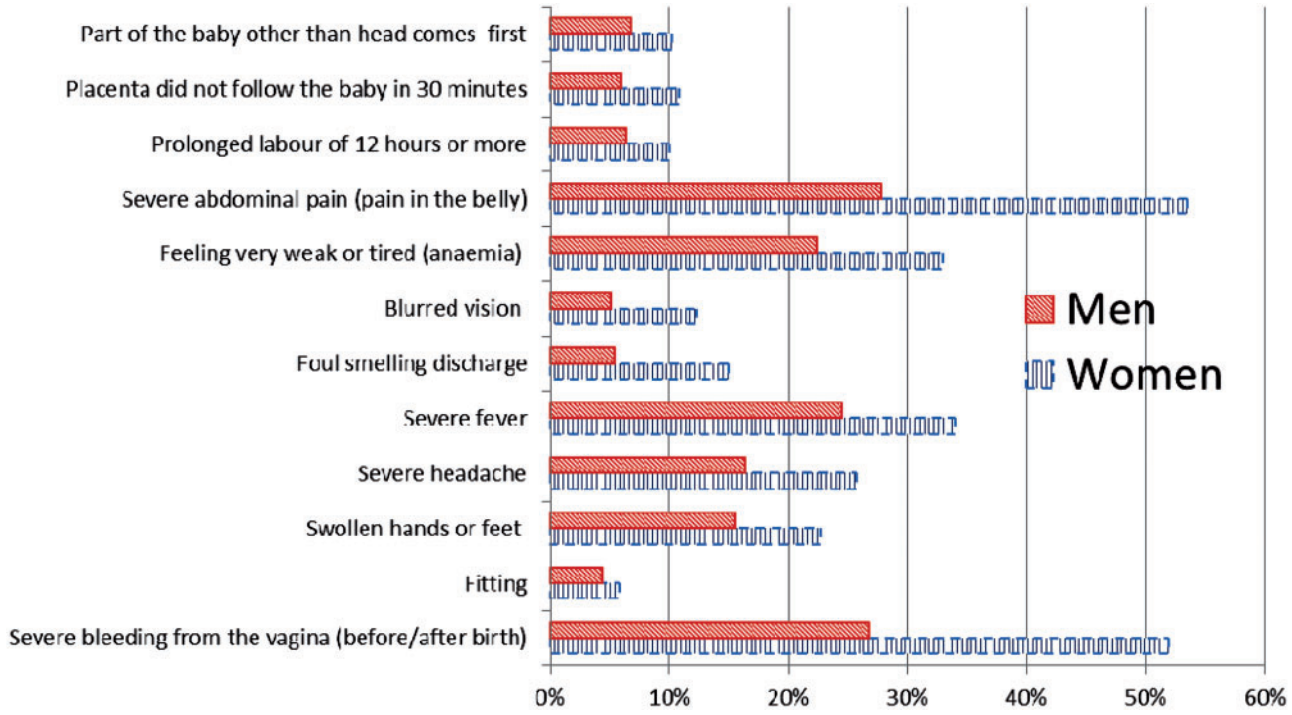

Figure 2 Knowledge of danger signs.

Knowledge of obstetric complications was measured in the survey by asking women to name all the danger signs that they knew. The most commonly reported signs were abdominal pain (54%) and bleeding (52%) (Figure 2). Just over 49% of women knew three (or more) of the danger signs. Two summary knowledge variables were constructed. First, a simple maternal knowledge count of the number of danger signs mentioned by women during interview. The second variable was the first component of a principal components analysis of knowledge of danger signs.

Three versions of the facility equation were specified: (1) the association between the number of antenatal visits on the probability of facility care; (2) the comparison of the effect of skilled and unskilled ANC; and (3) a model that makes use of the count knowledge indicator to understand the relative influence of knowledge and ANC on facility attendance.

The second set of analyses sought to understand the extent to which knowledge is associated with access to different types of ANC. The knowledge equation is specified as

$$K_i = A^c\beta_4 + Z_i\beta_5 + u_{Ki},$$

where K_i is the continuous maternal knowledge variable, A^c are bivariate variables representing choices about where a woman attends for ANC and Z_i are other variables likely to affect the level of obstetric knowledge including maternal education, age, parity and district. The knowledge count variable is used to investigate the association between knowledge, ANC and other factors. A Poisson and negative binomial (NB) model were used to analyse the data since linear and logarithmic transformations based on least squares did not provide well-specified estimations of the skewed knowledge variable. The (possible) feedback effect between knowledge and ANC gives rise to bias in the coefficients and requires a system (instrumental variables) approach to estimation.

Results

The intervention and comparison areas included in the baseline survey have similar characteristics: maternal health indicators, age, parity and maternal education are almost identical although a larger proportion of the sample is in the poorest group (Table 1). Characteristics of the sub-sample, which includes only women for which distance information is available, are similar in most respects to the sample as a whole.

The signs on variables for each of the three models were mostly as expected (Table 2). Some secondary and secondary or higher education was positively and significantly associated with facility delivery. Wealth effects were also evident with the richest quintile having a probability of facility delivery that is 25% higher than the lowest quintile. Distance is important for the more remote households: at mean values for other variables, households that were more than 20 km from a BEOC facility had a probability that was 22% lower than households that lived within 5 km of the BEOC. The number of previous pregnancies (parity) was negatively associated with facility delivery. This effect appeared to be moderated in older women. This finding implies that those that have a number of children at an early age are less likely to utilize facilities for delivery than older women.

The number of antenatal visits was associated with an increasing use of health facilities for delivery up to four visits but shows little change beyond this level (Figure 3).

The second model examines the association with type of ANC and suggests that almost all types of ANC were associated with a higher probability of delivery at a facility. This effect was highest for skilled ANC with four or more visits [Table 2, Equation (2)]. The exception is home-based ANC, which has a significant negative association with facility delivery.

Table 2 Associations between facility delivery, ANC, knowledge and other factors

	Equation (1): number of ANC visits		Equation (2): skilled or unskilled ANC		Equation (3): skilled or unskilled ANC (count knowledge variable)	
	Coef.	*z*	Coef.	*z*	Coef.	*z*
Knowledge index—PCA index	0.18	3.54*	0.21	4.00*		
Knowledge index—count					0.10	3.82*
Number of ANC visits[a]						
Visit 1	0.47	1.20				
Visit 2	0.74	2.14*				
Visit 3	1.13	3.70*				
Visit 4	1.52	5.03*				
Visit 5	1.09	3.34*				
Visit 6	1.37	3.85*				
Visit 7	1.24	2.64*				
Eight or more visits	1.39	3.02				
ANC skill type[b]						
Home ANC			−1.68	−2.39*	−1.68	−2.40*
Unskilled ANC (fewer than four visits)			0.75	1.99	0.73	1.95
Unskilled ANC (more than four visits)			1.24	3.45*	1.22	3.40*
Skilled ANC (fewer than four visits)			1.04	3.19*	1.02	3.13*
Skilled ANC (more than four visits)			1.44	4.47*	1.41	4.40*
Age	0.01	0.34	0.01	0.60	0.01	0.56
Parity	−0.35	−3.35*	−0.32	−3.10*	−0.33	−3.16*
Age–parity interaction	0.01	2.17	0.01	1.88	0.01	1.94
Asset quintiles[c]						
Low-middle	0.51	2.97*	0.52	3.01*	0.53	3.05*
Middle	0.59	3.29*	0.58	3.18*	0.59	3.23*
Upper-middle	0.57	2.97*	0.53	2.71*	0.54	2.74*
Upper	1.18	5.74*	1.19	5.69*	1.19	5.70*
Education[d]						
Some primary education	−0.04	−0.28	−0.01	−0.05	−0.01	−0.07
Complete primary	0.01	0.06	0.05	0.24	0.05	0.26
Some secondary	0.37	1.97	0.39	2.09*	0.38	2.06*
Completed secondary or higher	1.23	3.04*	1.15	2.80*	1.16	2.83*
Distance from community to BEOC (km)[e]						
6–12	−0.21	−1.10	−0.19	−0.98	−0.19	−0.99
12–20	−0.40	−2.17*	−0.48	−2.53*	−0.48	−2.55*
>20	−1.02	−5.86*	−1.00	−5.67*	−1.00	−5.69*
Constant	−1.00	−1.67	−1.09	−1.78	−1.32	−2.17*

Notes: Reference categories for dummy variables: [a]no visits, [b]no ANC, [c]poor quintile, [d]no schooling and [e]<6 km.
*P value ≤ 0.05. PCA: Principal Components Analysis.

Both the two knowledge variables exhibited a statistically significant association with facility-based delivery. The knowledge count variable [Table 2, Equation (3)] is easier to interpret. Marginal simulations of the interaction with skilled ANC were undertaken to examine the impact on the probability of facility delivery (other variables held at their mean value). These show, for example, that for women with unskilled ANC (fewer than four visits) increasing knowledge from four to eight danger signs increases the probability of facility attendance for delivery from 0.39 to 0.48.

The importance of the association between the distance and facility delivery raises the possibility that it may interact with the effect of skilled or unskilled ANC; women living further away from a facility may be more or less likely to be influenced to use a facility following ANC than those that are closer to a facility. Equation (2) was re-estimated for each of the four distance groups. The predicted probabilities of facility care suggest that the effect of ANC is particularly important for more remote communities (Table 3).

The preceding analysis assumed that antenatal visits and knowledge are independent control variables. Possible interaction between these variables is theoretically probable with ANC acting not only as a 'signpost' to supervised delivery but

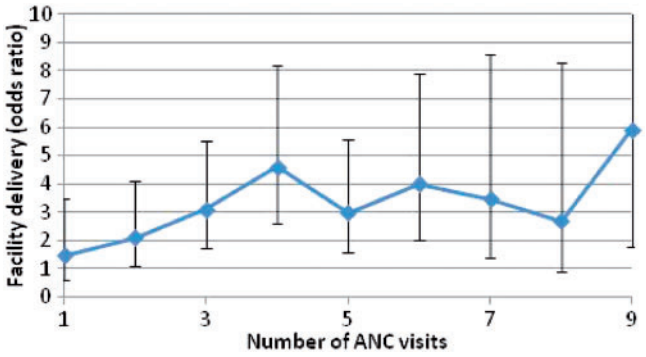

Figure 3 Odds ratio by ANC visits.
Note: Bars indicate 95% confidence intervals.

Table 3 Predicted probabilities of facility delivery by ANC provider, visits and distance from a facility

	Distance of community to BEOC facility (km)			
	<6	6–12	12–20	>20
No ANC	0.37	0.27	0.32	0.21
Home ANC	0.37	0.18	0.32	0.03*
Unskilled ANC (fewer than four visits)	0.52	0.49	0.43	0.31
Unskilled ANC (more than four visits)	0.36	0.42	0.56	0.51*
Skilled ANC (fewer than four visits)	0.46	0.47	0.49	0.39*
Skilled ANC (more than four visits)	0.66*	0.56*	0.54	0.47*

Note: *Indicator coefficient in regressor significant at least 5% level, detailed regression estimates available on request.

also itself improving a woman's health knowledge. These interactions were explored by examining the associations between the knowledge count variable and measures of ANC.

Three equations were estimated. The Poisson regression is predicated on the assumption that the variance of the dependent variable is not substantially larger than the mean (over-dispersion). Tests suggested significant over-dispersion so an NB specification, without the same restriction, was also estimated (over dispersion is confirmed by a significant alpha coefficient, $P < 0.01$). These specifications lead to similar but not identical coefficients [Table 4, Equations (4) and (5)]. Both equations suggest a modest but statistically significant association between skilled ANC ($P = 0.001$) and the count knowledge variable and a similar negative association with unskilled visits ($P = 0.03$).

Neither the above models take account of feedback (endogoneity) between ANC and knowledge variable; endogoneity was confirmed by a test that included residuals from a first-stage regression of ANC on instruments into the NB equation. A second equation used a generalized linear model (NB distribution at $\alpha = 0.139$) using instruments (wealth quintiles) for ANC. Accounting for this feedback increases the estimated impact of skilled ANC on the probability of a facility delivery via an indirect effect through the knowledge variable. At mean values for other variables, the overall estimated probability of facility attendance with skilled ANC (four or more visits) is increased from 0.52 to 0.59 when account was taken of the effect on knowledge. The effect of unskilled ANC is positive but not significant ($P = 0.27$).

Discussion

The study suggests that ANC care acts in two main ways to affect eventual birth outcome. As suggested by studies in other countries such as India, increasing contact with health practitioners appears to increase the likelihood of later use of a facility for delivery (Bloom *et al*. 1999; Mishra and Retherford 2008). A larger number of ANC visits are associated with increasing facility delivery up to a threshold level of about four visits. This effect is present for contact with both skilled and unskilled providers suggesting that this direct effect is largely linked to the development of a habit to use services at a facility rather than the knowledge imparted during the visit. ANC provided at home appears to reinforce the idea of staying in the village for delivery. Even going the short distance to receive ANC at a health post is positively associated with later use of a facility for delivery even though a health post can still be many kilometres from a health centre or hospital where deliveries are actually conducted.

The second effect of ANC care is through an association with health knowledge. Incorporating feedback effects suggest that while skilled ANC has a positive influence on knowledge of obstetric danger signs and hence to increase the likelihood of use of a facility for delivery, the same effect is not present for unskilled care. The modelled associations help to understand the coexistence of apparently high levels of ANC and relatively low use of delivery care. ANC appears to affect delivery care behaviour but only if contact with a practitioner is persistent and modelled through contacts at a facility rather than at home. Similar findings were reported in a Cambodian study which found that skilled ANC only was associated with later use of a facility for delivery (Yanagisawa *et al*. 2006). Skilled ANC also appears to have an educational effect on knowledge of maternal danger signs that enhance use of services particularly in remote areas.

Policy implications

The analysis reinforced the importance of supporting the uptake of ANC if it is with a skilled provider and offered at a facility (usually health centre, health post or hospital). ANC offered in the home appears to offer no benefit in terms of increasing use of facilities for delivery and may even put women off using facilities. This may be because services provided at home reinforce a practice of getting all care at home. Even going the short distance to receive ANC at health posts is positively associated with later use of facility delivery. Governments should perhaps focus efforts on increasing availability of regular ANC services at least at health posts in remote areas.

The interaction between location and the effect of ANC is striking. Influencing the uptake of skilled ANC appears particularly important for remote communities. One

Table 4 Associations between knowledge, use of ANC and other factors

	Equation (4): Poisson		Equation (5): negative binomial		Equation (6): negative binomial with endogenous regressors	
	Coef.	*z*	Coef.	*z*	Coef.	*z*
Education[a]						
Some primary education	0.04	1.11	0.04	1.11	0.06	1.22
Complete primary	0.04	0.78	0.05	1.09	0.03	0.53
Some secondary	0.05	0.96	0.04	1.03	0.05	0.78
Completed secondary or higher	0.31	3.55*	0.28	3.92*	0.20	1.46
Age	0.02	4.00*	0.02	3.90*	0.02	2.80*
Parity	0.05	2.17*	0.05	2.27*	0.07	1.78
Age–parity interaction	−0.00	−2.84*	−0.00	−2.84*	−0.00	−2.36*
ANC skill type[b]						
Skilled ANC (more than four visits)	0.08	2.59*	0.08	2.95*	0.79	2.34*
Unskilled ANC (more than four visits)	−0.15	−3.28*	−0.15	−3.08*	0.03	0.02
Districts[c]						
Mongu	0.03	0.47	0.01	0.14	0.20	1.78
Choma	−0.19	−3.29*	−0.21	−4.00*	−0.06	−0.27
Chama	−0.25	−4.67*	−0.27	−4.11*	−0.19	−0.78
Kaoma	−0.39	−7.26*	−0.42	−6.63*	−0.29	−1.28
Mkushi	−0.18	−3.75*	−0.20	−3.28*	−0.04	−0.40
Mazabuka	−0.51	−9.44*	−0.53	−9.67*	−0.34	−2.25*
Mbala	−0.37	−7.08*	−0.40	−7.32*	−0.34	−1.65
Mumbwa	−0.29	−6.76*	−0.31	−5.93*	−0.28	−1.35
Samfya	−0.18	−4.00*	−0.20	−3.26	0.01	0.04
Kapiri Moshi	−0.28	−5.05*	−0.29	−4.60	−0.21	−1.04
Constant	0.80	7.14*	0.83	7.93	0.36	1.02

Notes: Reference categories for dummy variables: [a] no education, [b] fewer than four visits and [c] Serenje district.
*Variables statistically significant at least at the 5% level; in Equation (5), α coefficient for over-dispersion was 0.133 ($P < 0.01$).

interpretation of this result is that if women in remote areas are persuaded to obtain ANC from a facility then they may gain a greater understanding of the riskiness of delivering in the community. Other explanations are possible and a causal understanding is likely to require more in-depth research of these pathways.

The study also suggests a policy focus on ensuring skilled ANC services and the content of care provided. This begs the question of how best to improve knowledge of health as an avenue to health care seeking behaviour. This can be done during ANC clinics but may also be influenced through community interventions such as those implemented through the MAMaZ programme. Initiatives that work with pregnant women, their husbands and communities more generally have the potential to increase substantially knowledge of danger signs and a willingness to act on these. For instance, an Maternal, Neonatal and Child Health programme implemented in three states of Northern Nigeria reported an increase in knowledge of at least four maternal danger signs from 25.1% at baseline to 91% at end-line after 14 months of implementation (Green 2011). A substantial behaviour change in birth preparedness and subsequent use of services for delivery accompanied the increase in knowledge. As a proportion of total deliveries, the proportion of women reporting use of a facility for complications of birth increased from 4% to 15%. Further work is required to examine the relative effectiveness of different ways of influencing obstetric knowledge of women.

Study limitations

The study was undertaken in 11 districts. There is no guarantee that it is representative of the country as a whole although utilization is similar to that recorded in recent nationwide surveys. The proportion of women that deliver in a facility (47%), for example, is comparable to the levels recorded by the Demographic Health Survey in 2007: 48% across the country as a whole and 33% in rural areas. Recall is a problem with all studies of this type. Limiting the period between interview and delivery to maximum of 3 months was designed to minimize this problem. Although interviewers noted that women appeared to have little difficulty in recalling where they delivered, qualifications of staff are more problematic and we cannot be sure that women could always identify whether the person attending the delivery was medically trained. The most problematic questions were the assessment of knowledge about obstetric complications used to develop the knowledge index. This question is sensitive to the way in which it is asked particularly whether the interviewer prompts the woman with possible answers. Interviewers were instructed not to prompt

but in the context of a relatively long largely quantitative interview, we cannot be sure that this was always the case.

Future research

The study raises a number of questions for future research.

Generalizing the results

The study, undertaken in a relatively small number of areas in Zambia, suggests an association between regular contacts and later use of a facility for delivery. An immediate research question is whether the link between the number of antenatal visits and place of care can be generalized to other settings. Future research could examine how far this result changes across contexts and the reasons for these changes.

Mechanisms linking ANC to delivery care

A related line of enquiry is to examine the mechanisms that link ANC to later delivery. One hypothesis is that frequent visits normalize (or habituate) service use within a household or community. Such an effect is supported by other studies which, for example, show a link between uptake of family planning services and future use of a facility for delivery (Ahmed and Mosley 2002). Understanding these mechanisms is likely to require in-depth qualitative study to understand the process by which women, families and communities normalize behaviour. Understanding these mechanisms might help to develop new interventions that speed up the process of behaviour change.

Linking types of service use

A related line of enquiry is to examine other types of regular contact that encourage or discourage later use of essential services. Does regular contact with a practitioner for a chronic condition such as tuberculosis, HIV or diabetes, for example, affect later use of services for other conditions? Does regular contact with a medically related practitioner such as a pharmacist encourage a general willingness to access other medical services or is any behaviour change confined to future use of pharmacies?

Quality effects

It is probable that the quality of care will play an important role in determining how contacts affect later behaviour. Unsurprisingly, the study suggests that skilled ANC has a larger impact than unskilled care on knowledge of care. It is likely that poor quality contacts actively deter further use of services. Research might examine the size of the quality effect on later use.

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Conflict of interest

None declared.

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