Journal Pre-proof

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PII: S2666-5778(21)00013-7
DOI: https://doi.org/10.1016/j.xagr.2021.100015
Reference: XAGR 100015

To appear in: *AJOG Global Reports*

Received date: 24 November 2020
Revised date: 3 May 2021
Accepted date: 15 June 2021

Please cite this article as: Dr Abi MERRIEL , Ms Nashna MAHARJAN , Dr Gemma CLAYTON , Dr Miriam TOOLAN , Ms Mary LYNCH , Ms Katie BARNARD , Prof Tina LAVENDER , Dr Michael LARKIN , Dr Nisha RAI , Dr Meena THAPA , Dr Deborah M. CALDWELL , Dr Christy BURDEN , Dr Dharma S MANANDHAR , Prof Abigail FRASER , A cross sectional study to evaluate antenatal care service provision in three hospitals in Nepal, *AJOG Global Reports* (2021), doi: https://doi.org/10.1016/j.xagr.2021.100015

A cross sectional study to evaluate antenatal care service provision in three hospitals in Nepal

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Source of Funding: This study is funded through a University of Bristol Global Challenges Research Fund Pump Priming Award. The funder played no role in the study design

Abi Merriel is funded by a National Institute for Health Research (NIHR), Academic Clinical Lectureship for this research project.

Miriam Toolan is funded by a National Institute for Health Research (NIHR), Academic Clinical Fellowship for this research project.

This paper presents independent research funded by the National Institute for Health Research (NIHR) and the University of Bristol GCRF fund. The views expressed are those of the author(s) and not necessarily those of the University of Bristol, the NHS, the NIHR or the Department of Health and Social Care.

Conflict of interests: The authors report no conflict of interest.

Word Count: 4078

Short title: The current quality of antenatal care in Nepal

AJOG At a Glance:

A. Why was the study conducted? To understand antenatal care delivery measured against Nepali National Medical Standards to identify ways to improve care.

B. What are the key findings? Three-quarters of women attend the minimum four contacts, and over three-quarters seek care after the first trimester. All clinical care is delivered at appropriate time points in just over 40% of cases. Most women get information about pregnancy danger signs, but women don't remember them all. Almost half of women would prefer more privacy and over 1/3 did not participate much in decisions about their care.

C. What does this study add to what is already known? Key areas for quality improvement include encouraging women to access services in the first trimester, improving communication around key health messages and respectful care.

Keywords: Accessing Care, Antenatal care, Developing Countries, Nepal, Pregnancy care, Quality improvement, Service Evaluation.

Abstract

Background: Globally too many mothers and their babies die during pregnancy and childbirth, a key element of optimizing outcomes is high-quality antenatal care (ANC). The Government of Nepal have significantly improved ANC and health outcomes through high-level commitment and investment, but still only 69% attend four recommended antenatal appointments.

Objective: To evaluate the quality and perceptions of ANC in Nepal to understand the compliance with Nepalese standards.

Study Design: This cross-sectional study took place at a tertiary referral and private hospital in Kathmandu, and a secondary hospital in Makwanpur. It recruited 538 female inpatients on postnatal wards during the two-week data collection period in May/June 2019. A case note review and verbal survey of women to understand the pregnancy information they received and their satisfaction with ANC was performed. We created a summary score of the completeness of ANC services received ranging 0-50 (50 indicating complete accordance with standards) and investigated the determinants of attending 4 ANC visits and patient satisfaction.

Results: The median ANC attendance was 4 visits at the secondary and referral hospitals and 8 at the private hospital. 24% attended less than 4 visits. 22% (117/538) attended a first trimester visit and 12% (65/538) attended visits at all points recommended in the standards. Over 90% of women had blood pressure monitoring, hemoglobin estimation, blood grouping and Rhesus typing, HIV and syphilis screening. 50% of women had urinalysis at every visit (IQR 20 to 100). 95% (509/538) reported receiving pregnancy information, but retention was variable: 93% (509/538) received some information about danger signs, 58% (290/502) remembered headaches whereas 98% (491/502) remembered fluid leaking. The ANC completeness score revealed the private hospital offered the most complete clinical services (mean 28.7, SD=7.1) with the secondary hospital performing worst (mean 19.1, SD=7.1). The factors influencing attendance at 4 ANC visits in the multivariable model were beginning ANC in the first trimester (OR 2.74 (95% CI 1.36, 5.52) and having a lower level of education (no-school OR 0.46 (95% CI 0.23, 0.91), Grades 1-5 OR 0.49 (95%CI 0.26, 0.92)). Overall 56% (303/538) of women were satisfied with ANC. The multivariable analysis revealed satisfaction was more likely in women attending the private hospital compared to the referral hospital (OR 3.63 95% CI 1.68 to 7.82) and lower in

women who felt the ANC facilities were not adequate (OR 0.35 95% CI 0.21 to 0.63) and who wanted longer antenatal appointments (OR 0.5 95% CI 0.33 to 0.75).

Conclusions: Few women achieved full compliance with the Nepali ANC standards, however, some services were delivered well. To improve, each antenatal contact needs to meet its clinical aims and be respectful. To achieve this communication and counselling training for staff, investment in health promotion and delivery of core services is needed. It is important that these interventions address key issues, such as attendance in the first trimester, improving privacy and optimizing communication around danger signs. However, they must be designed alongside staff and service users and their efficacy tested prior to widespread investment or implementation.

Introduction

Reducing maternal and neonatal morbidity and mortality is a key element of the Sustainable Development Goals. The maternal mortality ratio in Nepal has dropped from 553 per 100,000 live births in 2000 to 186 in 2017,[1] whilst the neonatal mortality ratio has halved from 40 per 1000 livebirths in 2000 to 20 in 2015.[2] Nepal has achieved this, despite a shortage in midwives, [3] through high level political commitment and significant investment in free maternity care, incentivised attendance at four antenatal appointments, and promotion of skilled attendance at birth.[4] Attendance at antenatal appointments and skilled health personnel have been shown to have a significant impact on reducing perinatal mortality,[5] and incentivisation has shown that

although women are no more likely to initiate care, they attend more frequently[6] which is important as reduced care results in increased perinatal death.[5]

Antenatal care (ANC) provides an opportunity to identify and manage risk, educate about pregnancy and birth and improves pregnancy outcomes.[7,8] The Nepali standards at the time of this study[9] recommended that women are seen four times during pregnancy, however recent WHO guidelines recommend eight contacts,[7] as do the new Nepali standards.[10] A summary of Nepali recommendations at the time, based on the reproductive health standards (2007) is presented in supplementary file 1.[9] According to the Nepal Demographic Health Survey, the first antenatal visit is attended by 84 % of women, but only 69 % attend all four.[11]

Attended birth is one of the most effective interventions for reducing perinatal mortality in low and middle income countries.[5] ANC has been shown to facilitate this,[12,13] and Nepalese ANC focuses on encouraging skilled attendance at delivery, preferably in a facility. In the most recent demographic health survey, 57% of women delivered at a facility, an increase from 36% in 2011.[11] Poor interactions with healthcare workers are thought to discourage women from delivering at a facility.[14] Therefore the quality of ANC, in addition to the coverage is likely to be important.[15] However, until recently there were few studies focusing specifically on the quality of ANC.[15,16]

Our aim was to perform a cross-sectional service evaluation of women delivering hospitals (thus likely to have attended ANC), to assess current ANC practices in Nepal, and women's perceptions of them. We measured the clinical services according to the Nepali standards at the time (the National Medical Standards 2007) [9] to identify targets for improvement. Alongside

this, we assessed some key elements of respectful care [17] and asked general questions about satisfaction with ANC.

Materials and Methods

This study took place in three hospitals in Nepal: a tertiary referral hospital in Kathmandu with 19,000 deliveries annually, a private secondary care teaching hospital in Kathmandu with 3,600 deliveries per year and a district secondary care hospital in Makwanpur with 2500 deliveries. All have routine ANC run by doctors, as is the norm in Nepal, and comprehensive emergency obstetric care. All accept referrals from surrounding smaller health facilities, and the referral and secondary hospital participate in the incentive scheme for attending four antenatal visits. The referral hospital receives country-wide referrals. These three sites were selected to access a diverse group of patients and represent different elements of Nepal's health system to provide a diverse snapshot of current antenatal care.

A cross-sectional study of women on the postnatal ward over a two-week period in May/June 2019 were eligible for inclusion in the survey. We obtained written informed consent and then study data collectors examined each woman's handheld maternity record and extracted the information contained within it onto a proforma. The data collected covered the core elements of ANC included in the Nepali National Standards[9] This included data on the woman, her history, what care she received and the information she was provided with. The English version of the data collection tool is available in supplementary file 2.

We also carried out a structured interview, in Nepali, to determine the information women recalled about pregnancy and danger signs and their satisfaction with ANC. The English version of the tool is available in supplementary file 3.

Data collection was piloted with 5-10 women and refinements made for ease of understanding and usability. Four research assistants were trained to collect the data. We offered participation to every woman delivering in the private and secondary hospitals, and from every other woman on the postnatal ward in the referral hospital (due to logistic constraints on staff time).

Data were recorded on paper forms and entered into EpiData version 3.1[18] by trained research assistants. Data monitoring was performed by the local project manager to ensure accuracy and integrity. It was then transferred to Stata V.15.1[19] to conduct all data checking, cleaning and analyses. Continuous and categorical data were summarized using means, SD, medians, IQR, ranges, counts and percentages by hospital and overall as appropriate. To test differences by hospital we used ANOVA to test means, the Kruskal Wallis test to investigate medians and Fishers exact test to assess whether proportions differed by hospital. P-values are reported.

We also developed an ANC completeness score based on Nepalese standards, indicating whether clinical services were delivered and whether they were delivered at the recommended time.[9] Details of the score that ranges from 0-50, with 50 indicating better performance. We acknowledge that there is much debate on the development of a score to measure ANC utilization[20] and that there are also many scoring systems to measure ANC quality[21] however, with this completeness score we were aiming to provide a quantitative estimate of the extent to

which the Nepali standards were followed. We therefore felt that it was possible to develop a score, specifically for this study, and present its composition in supplementary file 4.

We used logistic regression to identify whether demographic features, time to travel to the appointment, attendance in the first trimester, satisfaction or hospital were associated with a woman's likelihood of attending four or more antenatal visits. All variables hypothesized to have an impact on attending four antenatal visits were included in both univariable and multivariable models. We also assessed whether demographic features, completeness of ANC, and whether women were happy with the duration of appointments, privacy, level of decision making, facilities, and the number of appointments were associated with overall satisfaction. Any univariable determinants with a p value <0.2 were included in a multivariable model, whilst retaining hospital, ANC completeness, parity and time to travel to appointment regardless of statistical significance.

The Family Welfare Division of Nepal, the government department responsible for implementing maternal and child health policy, and the heads of the obstetric departments of each of the hospitals were involved in setting the priorities for this study. The study was reviewed and refined by the University of Bristol and Nepal Health Research Council's peer review process during ethical review.

Results

A total of 538 women participated in the study across all three sites (371 referral, 98 secondary, 69 private). 545 were interviewed, however 7 did not have their ANC cards (4 from the private

hospital, one from the secondary and two from the referral hospital) and therefore were excluded. All women who were approached agreed to participate.

Characteristics of participants

Women's characteristics, by recruitment center, are presented in Table 1. Women attending the private hospital were slightly older and were more likely to be primiparous. They were less likely to be homemakers and more likely to work in the service industry. A large proportion of women attended multiple locations for their ANC, however more women received all their care at the private hospital (74%) whereas, at the secondary hospital this was the case in only 24%. Women lived further from the referral hospital and closest to the secondary hospital, to which most women walked.

Core ANC Clinical Services

The results of the measures of clinical services are presented in table 2. Services delivered at appropriate times for over 90% of women across the three sites include: blood pressure monitoring, hemoglobin testing, blood grouping and Rhesus typing, HIV and syphilis screening. Some were carried out less reliably, for example documentation of relevant medical history was not performed at the first visit for 89% of women in the secondary hospital but was more reliably taken at the other two sites. Whilst fetal heart rate monitoring was undertaken consistently at the secondary hospital, it was less consistent at the other two sites.

Although most women had urinalysis for the detection of pre-eclampsia at least once over the course of their pregnancy, Nepali standards[9] state it should be taken at every visit. This only happened at 50% of visits, with the fewest in the private hospital and the most at the referral

hospital. When considering folic acid, although 88% were offered folic acid at their first visit, these benefits are diminished if not offered in the first trimester and overall only 22% attended a visit during the first trimester.

The mean ANC completeness score was 21.3 out of 50. The mean score at the referral hospital was 20.6, at the secondary hospital was 19.1, with the highest at the private hospital with 28.7. The private hospital was on average 8.1 (95% CI 6.4 to 9.8) points higher than the referral hospital whilst the secondary hospital, was 1.5 (95% CI -3.0 to -0.01) points lower than the referral hospital.

Pregnancy information including danger signs

Information about pregnancy and its danger signs is vital to facilitate early diagnosis and access to a health facility for treatment of complications. This information includes counselling on family planning, nutrition, breastfeeding, attendance at a minimum of four ANC visits, birth preparedness and promotion of institutional delivery.[22] We collected this data from two perspectives: what women report (presented in figure 1) and what was recorded in the hand-held notes (presented in table 3). There are differences, with women reporting that they receive more information than is documented in the notes. For example, at the secondary hospital it was recorded that 14% of women received advice on danger signs (table 3), but over 90% of women reported receiving information on all the danger signs (figure 1).

Overall, most women reported receiving some information about pregnancy (93%) and danger signs (93%). However, this may not have been comprehensive, as overall 58% of women remembered information on headaches whereas up to 98% remembered discussing fluid leaking.

The importance of diet and nutrition was almost universally discussed (98%) with a high rate of information about physical activity (94%). Other information was discussed more variably, for example sexually transmitted diseases, labor, and breastfeeding were discussed with less than 70% of women, and family planning with just 42%.

There were key differences in the information retained by women, between sites (figure 1). For example, at the secondary hospital, 90% or more women remembered about all the danger signs, but headache for example was only remembered about half the time in the referral and private hospitals.

ANC visits

ANC attendance and core services are displayed in table 2. The number of visits attended are a key indicator. The median number of ANC visits attended was 5, exceeding the expectations of the Nepali standards at the time. In the secondary and referral hospitals, the median number of visits was 4, however in the private hospital women attended a median of 8 visits. 76% of women attended at least 4 ANC visits, the minimum required in Nepal. Of those who did not attend 4 visits, 2% attended one (11/538), 10% two (54/538) and 12% three (64/538).

The first trimester visit facilitates optimal pregnancy planning and the Nepali standards[9] state that the first visit should be in the first trimester. In the private hospital 49% of women attended by the end of their 12th week. This dropped to 27% in the secondary hospital and 15% in the referral hospital. Furthermore, most women did not attend their ANC checkups at the times

recommended by the Nepali standards. Across all sites, only 12% of women achieved the recommended schedule, with the most achieving this in the private hospital (36%) and the least in the secondary hospital (7%).

In the multivariable model investigating the factors affecting attending 4 ANC visits the only two factors that seemed to influence it were beginning visits in the first trimester (OR 2.74 (95% CI 1.36, 5.52) and having a lower level of education with those that didn't attend school (OR 0.46 (95% CI 0.23, 0.91) or attended just the early years of school (OR 0.49 (95%CI 0.26, 0.92) being less likely to attend 4 ANC visits. The complete results of the univariable and multivariable model is presented in supplementary file 5.

Women's perceptions of ANC

When asking women their thoughts about their ANC (table 4), over 99% of women felt that antenatal care is important for their and their baby's health. In the secondary hospital, 43% were attending as a result of the incentive provided by the Government of Nepal, whereas in the referral hospital this dropped to 35% and in the private hospital this was just 2%.

Women were split about the need for more privacy with 49% preferring more privacy. There were variations between the three sites, with the private hospital having high levels of privacy and 89% wanting more privacy in the secondary hospital. In terms of decision making, 36% believed that they were not very involved in their delivery plans.

Overall, 62% of women felt that there were enough ANC appointments, this rose to 81% in the private hospital, with only 4% wanting more. In the secondary hospital 32% of women wanted more appointments, and in the referral hospital 26% wanted more. Time spent with a health care provider ranged from 2 to 30 minutes, 33% of women would like longer appointments, and this finding is similar across sites.

Women believed that they received satisfactory information about investigations in 53% of cases and satisfactory information about their test results in 41% of cases. In both of these cases the secondary hospital provided too little information to women, in the private hospital and the referral hospital provided relatively more information.

When considering their overall perceptions of antenatal care (figure 2), women were asked to rate their care from very satisfied to very unsatisfied, women were generally satisfied/very satisfied with their care, with women attending the private hospital being the most satisfied. Overall, 62% would go back to the hospital they attended in a future pregnancy, and 84% would recommend their facility to a friend/family member.

In the multivariable model, the odds of being satisfied with ANC were higher in the private hospital compared to the referral hospital (OR 3.63 95% CI 1.68 to 7.82) and lower if women felt they did not have adequate ANC facilities (OR 0.35 95% CI 0.21 to 0.63) and wanted longer antenatal appointments (OR 0.5 95% CI 0.33 to 0.75). The final multivariable model included demographic measures, ANC completeness score, time to travel, parity, hospital, opinions on care, facilities, and number of appointments. The full results of the univariable and multivariable regression are presented in supplementary file 6.

Structured Discussion :

1. Principal Findings

Women were in general positive about their ANC. They understood that it was important and most attended the recommended minimum of 4 visits. However, few had visits in the timeframes specified by the Nepalese standards. This is reflected in the ANC completeness score by the fact that even in the best performing hospital (the private hospital) the mean 'score' revealed that women received less than 60% of the overall clinical assessments at the timepoints recommended by the Nepalese standards, with the two Government funded hospitals achieving less than half of the services on time.

This reflects, the significant missed opportunity that less than a quarter of women seek pregnancy care in their first trimester. Where approximately a quarter of the care is due to take place, including identifying potential risks (e.g. high blood pressure, diabetes, screen for rhesus status and syphilis, diagnose anemia) and provide interventions (e.g. dietary supplements and counselling).

In the regression analysis it is clear that hospital impacted on attendance at 4 visits and satisfaction. However other key elements were receiving clinical services, having long enough appointments and facilities.

Some important interventions were carried out consistently across sites, e.g. checking blood pressure and monitoring for syphilis. However, elements of care, e.g. taking a relevant history at the first visit, were carried out less frequently, with the secondary hospital performing particularly poorly. The ANC completeness score reflects these findings as there is a clear

difference in achieving the required clinical care across the three sites. This means that risk is not reliably identified, and appropriate plans may not be made. Furthermore, many women report that they would like more information, involvement in delivery plans and privacy.

2. *Results*

The most recent demographic health survey suggests that only 45% of women in Nepal attend all 4 antenatal visits.[11] Previous studies in Nepal have suggested that attendance is determined by accessibility, geography, education, family support, ethnicity and socioeconomic status.[23,24,25,26]Our participants somewhat reflected this in terms of those who were lower educated being less likely to achieve 4 ANC visits. However, most women lived close to their care, in an urban area, and were well educated. However still, only a modest proportion of women received appointments at all time points recommended in the national standards. Furthermore, in other studies rural women are less likely to have checkups as per standards, which is reflected in our ANC completeness score being lowest in the secondary hospital compared to the other two.[26] With the introduction of the new Nepali standards,[10] women should receive eight contacts, raising further the expectations of care placed on the staff and system.

Similar to other Nepali studies, we found some services were carried out well, e.g. blood pressure monitoring.[23] However, Joshi et al found that health education was carried out well, but we report that not all of the danger signs were adequately communicated. A lack of this knowledge has been identified as a reason for people to not seek care in Nepal.[27] A further missed opportunity was in the first trimester. The lack of coverage of an early visit has been identified as an important issue with implications for both inequalities and outcomes.[28] This may

be a particular problem in Nepal as early pregnancy is often concealed,[14,27] and therefore addressing it may require innovative solutions.

Risk stratification is used to make decisions on appropriateness of place of birth.[29] This is carried out in practice, through clear history taking and documentation, two areas that this study has identified could be improved across all sites.

Respectful care is vital and providing women with privacy has emerged as an important issue[17] and could contribute to a woman's decision to seek care.[30] Furthermore, over 1/3 of women do not feel involved in their care. Cultural issues could contribute to this as family members, especially mothers-in-law, make many health decisions.[31] However, the way that the health-workers are used to involving women is likely to also have an impact. Disenfranchising women from decision making may mean that ANC is a negative experience, and it may result in women not attending subsequent visits.

3. Clinical Implications

Most of the women in the study did attend the recommended 4 visits, however 24% still had less than four appointments. When considering current reproductive health policy, the Government's 'Aama Surakshya' incentive scheme received interesting feedback with less than half of women, even at the rural hospital, attending for this reason.

In terms of clinical care, it is vital that staff complete all the recommended screening tests and also document the mother's history in antenatal cards, so that there is clear communication between professionals. Consistently carrying out urinalysis is important to identify pre-eclampsia and prevent pre-term birth. Interestingly, it was least reliably performed in the private hospital,

and most at the referral hospital. Interventions such as dietary supplements were not offered consistently to women at the first visit and this presents an important opportunity to maximize the effectiveness of these interventions, especially at the private hospital.

Providing high quality information is a key element of antenatal care. Educating women about pregnancy danger signs is sometimes missed. They are mentioned to most, but specific details are not to half of women in the referral and private hospital. It is imperative that danger signs are communicated to women, as awareness can provide the opportunity to intervene to optimize outcomes. Furthermore, less than half of women receive information about family planning, with sexually transmitted infections and breastfeeding only being discussed with about two-thirds of women. Interestingly, in the 2016 demographic health survey, only 66% of infants were exclusively breastfed by 6 months[11] and therefore there is an opportunity to improve the breastfeeding rate.

Ways of improving the information women receive include harnessing the lessons learnt from the implementation of participatory action cycles in Nepal and elsewhere, which supported women in developing knowledge around pregnancy and birth.[32] Furthermore, models such as group antenatal care can bring improvements in both clinical care, but also make care more woman-centered, drive demand for services and provide women with peer support.[33]

Women have identified the need for respectful care to be improved. This study addressed only specific elements of respectful care included within the Respectful Maternity Care Charter[17]

including whether women: have privacy during their antenatal consultations; are able to make informed decisions around their care; and that they are cared for in a clean and safe environment. We have identified that approximately half of women would like more privacy during their care, and that this is particularly a problem in the government funded rather than the private health setting. Furthermore, over a third of women do not feel that they are fully involved in making decisions about their care. However, three quarters of women felt that their antenatal care facilities were adequate. There is limited evidence about how to improve respectful care and privacy in particular, but basic ideas include partitions between beds,[34] however other initiatives for example timed appointments to reduce overcrowding could be considered.

5. Research Implications

The women participating in this study were women on the postnatal wards and therefore had generally attended ANC. They have identified clear areas for further research including the need to work with women to develop a way to encourage attendance at ANC in the first trimester; the need to work with staff and women to develop ways to improve communication in consultations especially about danger signs; and also, to develop ways to better involve women in decision making. As this study was based in the post-natal wards of hospitals, it will now be important to garner views from women who chose not to attend antenatal care, to understand the barriers to ANC attendance from their perspective.

5. Strengths and Limitations

A strength is that we examined care at three levels of the Nepali health system with one site being remote from Kathmandu. This allowed to compare findings across these settings and their patient populations, and means that our findings are generalizable to the diverse population of women receiving ANC in these settings. Whilst the sample was relatively small the 538 women who did participate allowed us to gain an understanding, of the services that were delivered and how women feel about it. However, due to the different nature of the facilities, it meant that the size and composition of the samples from each site were varied.

Due to the time and financial constraints, we focused on large secondary-care units. This may mean that rural women with uncomplicated pregnancies were not accessed. Furthermore, this study only included women who attended for delivery care, which may have skewed results.

A further limitation was that this survey is confined to women, and therefore the perspectives of healthcare workers were not obtained. As we did not follow up with in-depth interviews, we were unable to understand the root causes of any of the issues surrounding attendance or understanding, e.g. why women do not attend in the first trimester.

6. Conclusions

Some antenatal services are delivered well. However, to ensure that maternal and newborn outcomes are optimized, there are some areas for focus. Each contact with a healthcare worker needs to be valuable and meet all of its aims in terms of basic clinical service delivery, information sharing and documentation. To achieve this, focusing on training for staff and investment in health promotion and core services is needed. It is important that these interventions to address key issues (attendance in the first trimester, improving privacy and

optimizing communication around danger signs), are designed alongside staff and service users and their efficacy is tested prior to widespread investment or implementation.

Acknowledgements:

This study would not have been possible without the support of staff and the participation of the clinicians and women in the participating hospitals in Nepal. We would also like to thank the research assistants who worked tirelessly to complete the study in a challenging timescale, and who were invaluable in ensuring that the research tools were well designed.

Contribution of authorship:

AM conceived the study, secured the funding, developed the protocol, participated in the analysis and wrote the first draft of the paper. NM supported the protocol development, managed the data collection and entry and inputted into the first draft of the paper. GC undertook the statistical analysis and contributed to drafting the paper. MTo contributed to the funding application, protocol, interpretation and the first draft of the paper. MLy & KB contributed to the protocol, interpretation and final draft of the paper. TL, MLa, DC, CB, DSM, AF contributed to the conceptualization of the project, funding application and the final draft of the paper. NR& MTh provided local knowledge for the protocol, access to patients and contributed to the final draft of the paper.

Details of ethical approval:

This study was approved by the Nepal Health Research Council (ref 2245), the University of Bristol Faculty of Health Sciences Research Ethics Committee (ref 79223), The research ethics committees at the three participating hospitals: Paropakar Maternity and Women's Hospital, Kathmandu Medical College and Hetauda Hospital.

Funding

This study is funded through a University of Bristol Global Challenges Research Fund Pump Priming Award. The funder played no role in the study design

Abi Merriel is funded by a National Institute for Health Research (NIHR), Academic Clinical Lectureship for this research project.

Miriam Toolan is funded by a National Institute for Health Research (NIHR), Academic Clinical Fellowship for this research project.

This paper presents independent research funded by the National Institute for Health Research (NIHR) and the University of Bristol GCRF fund. The views expressed are those of the author(s) and not necessarily those of the University of Bristol, the NHS, the NIHR or the Department of Health and Social Care.

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Table/Figure caption list

Table 1: Characteristics of participants by each hospital

Table 2: ANC Attendance and core services

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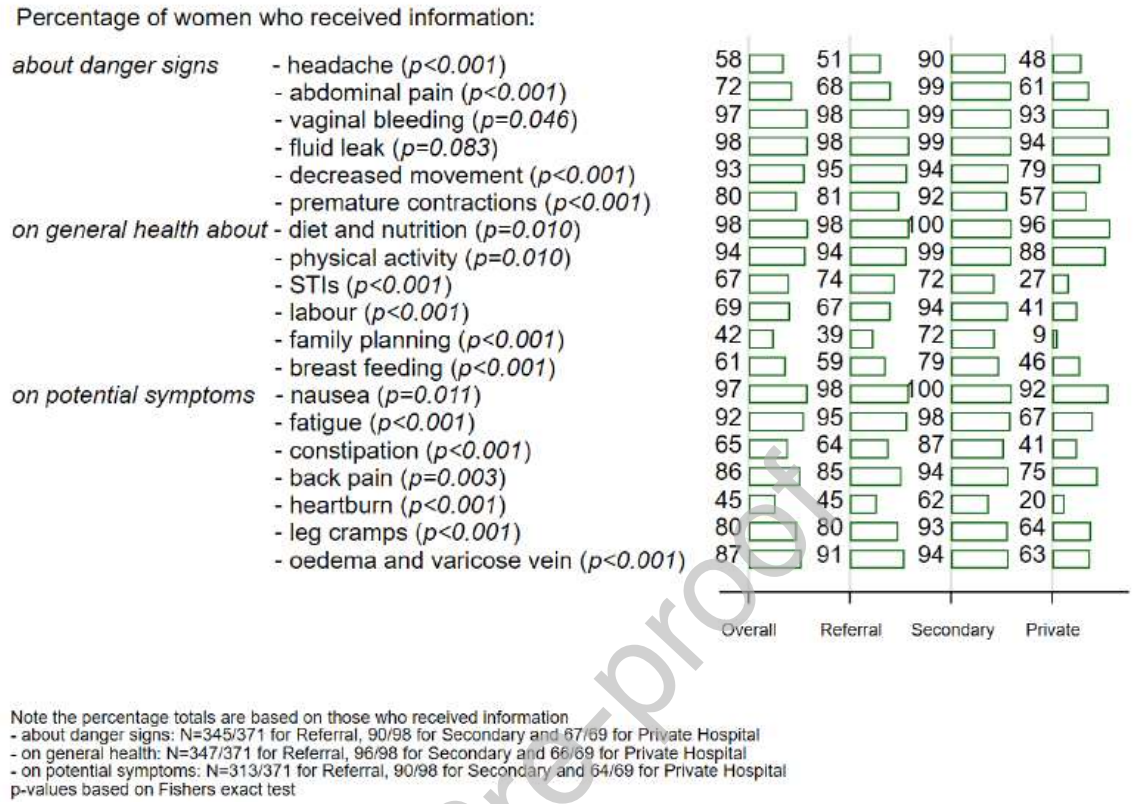

Figure 1: Information received about pregnancy and danger signs

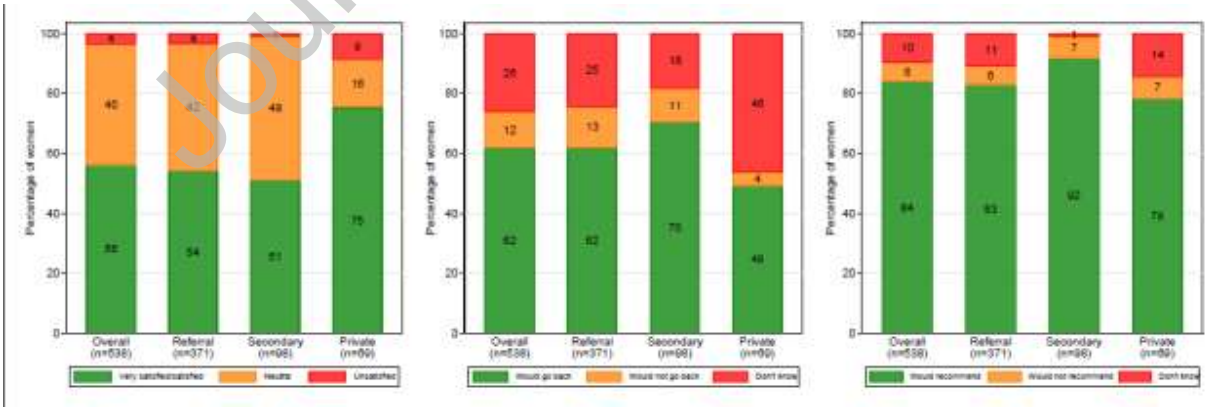

Figure 2: Women's satisfaction with antenatal care

	Referral Hospital	Secondary Hospital	Private Hospital	

Table 1: Characteristics of participants by each hospital

		(N=371)		(N=98)		(N=69)		P value
Age (years) (Mean, SD)		24.3	4.6	23.4	3.8	26.5	4.4	<0.001
Employment status (n,%):	housemaker	287	77%	77	79%	40	58%	<0.001
	service	21	6%	2	2%	17	25%	
	business	49	13%	11	11%	10	15%	
	other	9	2%	8	8%	2	3%	
	Manual labor	5	1%	0	0%	0	0%	
% who had all ANC at this hospital		237	64%	23	24%	51	74%	<0.001
Time taken to travel to ANC (Median, IQR)		30	(20, 60)	20	(10, 30)	25	(15, 30)	<0.001
Transport to ANC (n,%):	Public Transport	212	57%	52	53%	34	49%	<0.001
	Walking	102	28%	45	46%	12	17%	
	Private vehicle	36	10%	1	1%	14	20%	
	Taxi	21	6%	0	0%	9	13%	
Level of education (n,%)	Illiterate	15	4%	3	3%	4	6%	<0.001
	Basic reading and writing	31	8%	0	0%	0	0%	
	Grade 1 to 5	53	14%	9	9%	5	7%	
	Grade 6 to 10	158	43%	62	63%	20	29%	
	Intermediate	77	21%	21	21%	18	26%	
	Bachelors	28	8%	2	2%	16	23%	
	Masters	9	2%	1	1%	6	9%	
Parity (multips) (n,%)		134	36%	39	40%	33	48%	0.175

Table 2: ANC Attendance and core services

* completeness score calculated using data from table 2 and 3 according to visit as presented in supplementary file 4.

Summary statistics by hospital	**Referral Hospital (N=371)**	**Secondary Hospital (N=98)**	**Private Hospital (N=69)**	**Overall (N=538)**	**P value**
Number of routine antenatal visits Median (IQR)	4 (3 , 6)	4 (4 , 5)	8 (7 , 9)	5 (4, 6)	<0.001
% (n)who attended a visit in the 1st trimester	15% (57)	27% (26)	49% (34)	22% (117)	<0.001
Weeks of gestation at first contact Median (IQR)	20 (15 , 26)	16 (13 , 16)	13 (8 , 17)	18 (13, 23)	<0.001
%(n) who attended all within the specified time frames*	7% (25)	15% (15)	36% (25)	12% (65)	<0.001
Percentage of visits bp was taken (Median, IQR)	100 (88 , 100)	100 (75 , 100)	90 (83 , 100)	100 (80, 100)	0.001
Percentage of visits urine dip stick was taken (Median, IQR)	89 (43 , 100)	25 (17 , 25)	13 (10 , 17)	50 (20, 100)	<0.001
Hemoglobin estimation at least once %(n)	100% (369)	100% (98)	100% (69)	100% (536)	1.000
Blood grouping and Rh typing % (n)	100% (369)	100% (98)	100% (69)	100% (536)	1.000
All supplements offered on 1st visit %(n)	88% (328)	81% (79)	71% (49)	85% (456)	0.001
Screening tests (HIV/Syphilis) %(n)	98% (364)	100% (98)	99% (68)	99% (530)	0.458
Had VRDL taken at least once	98% (364)	93% (91)	99% (68)	97% (523)	0.023
Tetanus vaccination %(n)	95% (354)	80% (78)	96% (66)	93% (498)	<0.001
Had medical history taken on 1st visit %(n)	90% (332)	11% (11)	96% (66)	76% (409)	<0.001
Pattern of Fetal movements discussed %(n)	96% (367)	72% (71)	94% (65)	92% (492)	<0.001
Fetal heart rate – at percentage of visits (>=20 weeks (Median, IQR))	86(67, 100)	100 (67, 100)	80 (57, 100)	88 (67, 100)	0.009
Symphysis fundal height – at percentage of visits(>=20 weeks (Median, IQR))	100 (50, 100)	67 (33, 100)	100 (83, 100)	100 (50, 100)	0.001
Ultrasound scan prior to 24 weeks	52% (191)	27% (26)	81% (56)	51% (273)	<0.001
ANC completeness score* (Mean (SD))	20.6 (6.5)	19.1 (7.1)	28.7 (7.1)	21.3 (7.3)	<0.001

Table 3: Documented advice received by women at antenatal care

% receiving (n)	Referral Hospital (N=371)	Secondary Hospital (N=98)	Private Hospital (N=69)	Overall (N=538)	P value
advice on danger signs	64% (236/371)	14% 14/98	64% (44/69)	55% (294/538)	<0.001
nutrition counselling	1% (3/371)	1% (1/98)	61% (42/69)	9% (46/538)	<0.001
STI counselling	0% (1/371)	0% (0/98)	52% (36/69)	7% (37/538)	
birth preparedness counselling	8% (29/371)	5% (5/98)	3% (2/69)	7% (36/538)	0.326
contraceptive counselling	1% (2/371)	0% (0/98)	48% (33/69)	7% (35/538)	<0.001
breastfeeding counselling	0% (1/371)	0% (0/98)	51% (35/69)	7% (36/538)	<0.001
advice on nausea and vomiting	21% (78/371)	3% (3/98)	49% (34/69)	21% (115/538)	<0.001
advice on constipation	1% (3/371)	0% (0/98)	12% (8/69)	2% (11/538)	<0.001
advice on back and pelvic pain	5% (18/371)	10% (10/98)	51% (35/69)	12% (63/538)	<0.001
advice on heartburn	0% (0/371)	0% (0/98)	0% (0/69)	0% (0/538)	n/a
advice on oedema and varicose veins	74% (275/371)	1% (1/98)	73% (50/69)	61% (326/538)	<0.001
advice on smoking	1% (4/371)	1% (1/98)	54% (37/69)	8% (42/538)	<0.001

Table 4: Women's perceptions of antenatal care.

	Referral Hospital (N=371)	Secondary Hospital (N=98)	Private Hospital (N=69)	Overall (N=538)	P value
General antenatal care					
Attending antenatal appointments is important	100% (370/371)	100% (98/98)	97% (67/69)	99% (535/538)	0.041
for own health	97% (360/370)	99% (97/98)	88% (59/67)	96% (516/535)	0.001
for baby's health	98% (361/370)	100% (98/98)	100% (67/67)	98% (526/535)	0.216
for incentive	35% (131/370)	43% (42/98)	2% (1/67)	33% (174/535)	<0.001
If No is it because you couldn't take time off work?	100% (2/2)	100% (1/1)	0% (0/2)	60% (3/5)	0.200
Antenatal Appointments					
Received enough antenatal appointments:					
Yes	57% (212/371)	67% (66/98)	81% (56/69)	62% (334/538)	<0.001
Want more	26% (97/371)	32% (31/98)	4% (3/69)	24% (131/538)	
Want less	5% (18/371)	0% (0/98)	7% (5/69)	4% (23/538)	
Unknown	12% (44/371)	1% (1/98)	7% (5/69)	9% (50/538)	
Time spent with health care provider (Median, IQR, Range)	10 (5, 15) (2, 30)	10 (5, 10) (2, 25)	15 (10, 20) (5, 30)	10 (5, 15) (2, 30)	<0.001
Happy with the duration of your appointments:					
Yes	63% (235/371)	64% (63/98)	68% (47/69)	64% (345/538)	0.877
Want longer	34% (126/371)	34% (33/98)	29% (20/69)	33% (179/538)	
Want shorter	1% (2/371)	0% (0/98)	1% (1/69)	1% (3/538)	
Unsure	2% (8/371)	2% (2/98)	1% (1/69)	2% (11/538)	
Opinion about level of privacy					
privacy was ok	15% (57/371)	9% (9/98)	77% (53/69)	22% (119/538)	<0.001
prefer more privacy	46% (172/371)	89% (87/98)	6% (4/69)	49% (263/538)	
there was a lot of privacy	38% (141/371)	2% (2/98)	17% (12/69)	29% (155/538)	
Opinion about your involvement in decisions made about your delivery plans					
actively participated in plans	29% (107/371)	1% (1/98)	29% (20/69)	24% (128/538)	<0.001
moderate participation	32% (118/371)	68% (67/98)	38% (26/69)	39% (211/538)	
involvement not high	39% (143/371)	28% (27/98)	32% (22/69)	36% (192/538)	
I do not know	1% (3/371)	3% (3/98)	1% (1/69)	1% (7/538)	
Information received during pregnancy					
Had own copy of notes	100% (371/371)	100% (98/98)	88% (61/69)	99% (530/538)	<0.001
If yes were they helpful	93% (343/371)	67% (65/97)	90% (55/61)	88% (463/529)	
Received information about the reasons why investigations are carried out	94% (350/371)	95% (93/98)	93% (64/69)	94% (507/538)	0.374
Information was Too little	36% (127/350)	67% (62/93)	55% (35/64)	44% (224/507)	
Information was Moderate	44% (155/350)	33% (31/93)	38% (24/64)	41% (210/507)	
There was a lot of information	16% (57/350)	0% (0/93)	6% (4/64)	12% (61/507)	
I do not know	3% (11/350)	0% (0/93)	2% (1/64)	2% (12/507)	
Received test results	99% (367/371)	99% (97/98)	99% (68/69)	99% (532/538)	0.266
Information was too little	46% (170/367)	90% (87/97)	50% (34/68)	55% (291/532)	
Moderate	34% (124/367)	9% (9/97)	37% (25/68)	30% (158/532)	
A lot of information	14% (50/367)	0% (0/97)	13% (9/68)	11% (59/532)	
I do not know	6% (23/367)	1% (1/97)	0% (0/68)	5% (24/532)	
Received written information after ANC appointments	59% (217/371)	14% (14/98)	65% (45/69)	51% (276/538)	<0.001
If yes useful?	93% (202/217)	86% (12/14)	89% (40/45)	92% (254/276)	0.195
If not would you like to	74% (114/155)	86% (71/83)	35% (8/23)	74% (193/261)	<0.001

Supplementary file 1: Nepal Antenatal Care Standards

Supplementary file 2: Data collection tool

Supplementary file 3: Structured interview form

Supplementary file 4: Composition of ANC completeness score

Supplementary file 5: Factors influencing attendance at 4 ANC visits

Supplementary file 6: Factors influencing satisfaction with ANC