

# Global Health: Science and Practice

## Perspectives of rural Ugandan clinics on barriers to obstetrical care and cost analysis of equipping 12 rural Ugandan clinics with ultrasound and training for midwives --Manuscript Draft--

<b>Manuscript Number:</b>	
<b>Full Title:</b>	Perspectives of rural Ugandan clinics on barriers to obstetrical care and cost analysis of equipping 12 rural Ugandan clinics with ultrasound and training for midwives
<b>Short Title:</b>	Rural Ugandan perspectives on obstetrical challenges indicate need for ultrasound
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<b>Additional Information:</b>	
<b>Question</b>	<b>Response</b>
Please enter the key message. In one or two sentences (no more than 50 words), explain the "single overriding communication objective (SOCO)," or key message, of your manuscript, including the significance for action.	Survey of 12 rural Ugandan midwives' perspectives revealed lack of ultrasound as a major barrier to antenatal care and demonstrated knowledge deficiencies in managing prenatal conditions diagnosed with ultrasound. Project data includes cost analysis for equipping rural Ugandan clinics with ultrasound and formal obstetrical ultrasound training of the clinic's midwives.
Optional: Please enter acknowledgements including funding. You may cut and paste this from a word processing file but any formatting will be lost. The acknowledgements will not be visible to peer reviewers. Please note that acknowledgements should not be included in the uploaded manuscript file as they may contain information that will identify authors.	Funding source: Rad Impact, non profit organization
All authors must complete the ICMJE Uniform Disclosure Form for Potential Conflicts of Interest which can be downloaded from: <a href="http://www.icmje.org/coi_disclosure.pdf">www.icmje.org/coi_disclosure.pdf</a> . Though each author must complete the form, the forms do not need to be submitted to the GHSP journal. Instead, they should be kept on file by the corresponding author in the event that a question arises regarding the funding or competing interests related to this submission. Please acknowledge compliance with this requirement below.	Yes

Based on the ICMJE Uniform Disclosure Form, please declare any competing interests for the submitted work for you and your coauthors. If there are no competing interests, please indicate "None declared."	none declared
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I confirm that the research meets all appropriate and applicable ethical guidelines in both the US and the study country(ies).	Yes
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<b>Abstract:</b>	Like much of Sub-Saharan Africa, Uganda is facing significant maternal and fetal health challenges. Despite the fact that the majority of the Uganda population is rural and the major OB care provider is the midwife, there is a lack of data in the literature regarding rural health facilities' and midwives' perspectives on important issues such as current barriers to antenatal care (ANC) and deficiencies in prenatal services. First, an assessment of the perspectives of midwives at 12 rural Ugandan health facilities was performed, which revealed transportation as a major barrier to ANC and lack of ultrasound as a major deficiency in prenatal services. Second, an assessment of the current antenatal diagnostic and management capabilities of the midwives who have never received ultrasound training was performed, which highlighted deficiencies in many prenatal conditions such as placenta previa and macrosomia. Finally, a cost analysis of training and equipping ultrasound at 12 rural health facilities was performed and found to be \$6,888 per powered rural health facility and \$8,288 for non-powered rural health facilities in which solar power was required to maintain ultrasound.
<b>Keywords:</b>	Ultrasound; maternal health; fetal health; rural; midwives; Sub-Saharan Africa
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*Journal of Global Health: Science and Practice*

Dear Editor,

We are electronically submitting our manuscript entitled “Perspectives of rural Ugandan clinics on barriers to obstetrical care and cost analysis of equipping 12 rural Ugandan clinics with ultrasound and training for midwives.” In a survey of multiple rural Ugandan clinics and midwives, lack of access to ultrasound imaging was identified as a major barrier to providing antenatal care. For this reason, a project was undertaken to provide 12 clinics with ultrasound machines and formal training in their use. This paper describes briefly the details of such project and a cost analysis on a per clinic basis. Furthermore, an assessment of the current antenatal diagnostic and management capabilities of the midwives who have never received ultrasound training was performed, which highlighted knowledge deficiencies in many prenatal conditions. The authors of this paper reside both in the United States and Uganda. We adhered to ethical practice. Each author made a contribution and agrees with the final product. There are no conflicts of interest, and the manuscript is not submitted to any other journal. We believe the content of this manuscript is appropriate for the specific audience of the journal. We hope that the paper will be of interest to you, and appreciate you considering it for publication.

Sincerely,

A handwritten signature in orange ink that reads "Christina Kinnevey". The signature is written in a cursive style with a large, looping initial 'C'.

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**Perspectives of rural Ugandan clinics on barriers to obstetrical care and cost analysis of equipping 12 rural Ugandan clinics with ultrasound and training for midwives**

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## INTRODUCTION

Uganda, like much of Sub-Saharan Africa, is facing critical maternal and fetal health challenges. According to the 2011 Uganda Health Assessment, the Ugandan infant mortality rate is 76 infant deaths per 1,000 live births,<sup>1</sup> which is over 10 times the infant mortality rate as the United States.<sup>2</sup> According to the 2012-13 State of Uganda Children Report, Uganda's maternal mortality ratio is 438 per 100,000 live births, which is one of the highest rates in the world.<sup>3</sup>

The lack of antenatal health care is a contributing factor to Uganda's maternal and fetal health challenges. It is estimated that 6% of Ugandan women receive no antenatal care and the majority (68%) of women receive less than the recommended four antenatal care visits.<sup>1</sup> In fact, the minority (only 39%) of Ugandan women deliver at health facilities.<sup>1</sup> While the problem is severe in the country of Uganda as a whole, it is even worse in rural areas because of additional barriers faced in rural areas including the cost and reliability of transportation,<sup>4,5</sup> inadequate nutritional education,<sup>6</sup> long wait times caused by high patient volumes<sup>5</sup> and lack of imaging capabilities in rural areas.<sup>7</sup>

According to the 2011 Ugandan Health Assessment, 84% of women receive their antenatal care from midwives.<sup>1</sup> Since midwives comprise the majority of the antenatal care providers, there is compelling reason to seek their perspectives in facing Uganda's critical maternal and fetal health challenges. Despite the rich first-hand knowledge of the field conditions of the rural Ugandan midwives, the rural Ugandan midwives perspectives are not represented in the literature. The purpose of this paper is to assess the perspectives of rural Ugandan clinics on current barriers to antenatal care (ANC), deficient prenatal services and anticipated new demands with the addition of ultrasound. A further purpose is to assess rural Ugandan midwives perspectives' on the perceived challenges they will face by adding ultrasound to their health facilities and identify knowledge deficiencies in the management of prenatal conditions primarily diagnosed with ultrasound. The final purpose of this paper is to perform a cost analysis for the equipping of ultrasound at a rural Ugandan health facility.

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6 **METHODS**  
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10 **Subjects:** This study included a prospective survey of 12 rural Ugandan health facilities  
11 and 12 midwives that provide antenatal care (Table 1). Participation was on a voluntary  
12 basis without financial payments for completion of the survey.  
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16 **Procedures:** A Ugandan medical bureau worked with a 501(c)(3) Non-Profit  
17 organization and arranged for equipping of ultrasound at 12 rural clinics with a 6-week  
18 obstetrical ultrasound educational course accomplished in Kampala, Uganda in January  
19 2016. Two surveys were created and completed by a midwife from each of the 12 clinics.  
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26 The first survey was requested via email to clinic coordinators at the 12 health facilities  
27 between September - December 2015. The questions primarily consisted of inquiry  
28 regarding the clinic volume, prenatal services offered, funding, barriers women face in  
29 receiving antenatal care, prenatal services desired and anticipated needs with new  
30 ultrasound machines with answers predominantly in free text form.  
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37 The second survey was administered to 12 midwives on the first day of their ultrasound  
38 training at ECUREI in January 2016. The survey responses were anonymous and  
39 primarily consisted of questions regarding the midwives' practice with the majority of the  
40 questions centered on their practice parameters and capabilities in diagnosis and  
41 management of a variety of prenatal conditions.  
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48 The cost estimate was calculated as the sum of the ultrasound equipment including  
49 shipping and import tax fees plus the midwives' ultrasound training fees including  
50 tuition, transportation, room and board. Given the fact that five of the health facilities  
51 were solar powered, additional solar power would be required and these costs were  
52 summed for the total project cost. The ultrasound equipment was selected for suitability  
53 for limited obstetrical ultrasound and tested by several of the authors.  
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4 **Definitions and Criteria:** According to the Ugandan Health Sector Strategic Plan<sup>8</sup>, a  
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6 Health Center IV is the county-level health facility which employs a physician and is  
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8 equipped with an operating theatre and blood transfusion services. A Health Centre III is  
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10 a sub-county level health facility which is run by mid-level providers and offers basic  
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12 maternity services, diagnostic services and oversight to Health Centre II facilities. Health  
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14 Center II are the most basic health facilities and are limited to outpatient care. The  
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16 Health Centre I has no physical structure, but rather represents a team of people called the  
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18 village health team (VHT) that can interact with the health facilities and the community.  
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21 **Statistical Tests:** Summary statistics including mean, range, fractions and standard  
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23 deviations with 95% confidence intervals were used for reporting.  
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## 25 26 **RESULTS**

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30 **Survey 1:** Five health facilities (No 1, 4, 5, 6, 7 from Table 1) responded to the email  
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32 survey. In regards to the patient volume, the mean number of patients seen per month per  
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34 health facility for antenatal care was 95 with the range of 14 to 125. Four of the five  
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36 clinics performed vaginal deliveries and the one health facility that does not perform  
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38 vaginal deliveries (No 5) is in process of building a birthing center. One of the five health  
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40 facilities (No 6) performs C-sections. The reported source of funding for these clinics is  
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42 combination of fees paid by patients for services, government support and overseas  
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44 donations. In regards to barriers pregnant women face in attending antenatal care, the  
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46 two most common reasons included transportation/distance and lack of ultrasound  
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48 (Figure 1). In regards to additional prenatal services desired, but not currently offered,  
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50 four of the five health facilities reported ultrasound as a barrier and all four explained that  
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52 they expected that their volume would increase with ultrasound. Furthermore, these four  
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54 health facilities explained that they felt ultrasound would cause an increased demand in  
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56 human resources at the health facility because of the expected increased patient volume  
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58 related to ultrasound attracting more women for ANC.

59 **Survey 2:** All 12 midwives who were administered a survey on the first day of their  
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4 ultrasound training course submitted a completed survey. In the background section of  
5 the questionnaire, the 12 midwives revealed that they received their clinical training at 10  
6 different programs across Uganda. All of the 12 midwives see patients for antenatal  
7 appointments and only one responder does not currently assist with deliveries in her  
8 practice. All reported that all HIV positive pregnant women received anti-retrovirals  
9 (ARVs), provided free of charge to the patient. None of the midwives had ever received  
10 obstetrical ultrasound training as part of their curriculum. Further questionnaire results  
11 are reported in Table 2.  
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22 The second portion of the Survey #2 was an assessment of the midwives understanding of  
23 the diagnosis and the clinical significance and comfort level in management of eleven  
24 prenatal diagnoses primarily made with ultrasound. The means with the 95% confidence  
25 interval for each diagnosis are reported in Figure 4.  
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31 **Cost Analysis:** The ultrasound machine selected was the Mindray DP-10, which costs  
32 \$3219 USD per unit. The cost of the education was \$3669 per midwife. Thus, the total  
33 cost of implementing ultrasound equipment and training a midwife at a rural health  
34 facility in Uganda was \$6888. The solar panels selected were the JLR 500 Watt Solar  
35 Generator system, which was an additional \$1400 per unit. The nonprofit organization  
36 that funded this project worked with Rad Connect to provide free telecommunication  
37 service so the midwives could consult with experts.  
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#### 45 **Discussion:**

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50 The 12 midwives at the rural Ugandan health facilities in this study reported to manage  
51 over 6700 ANC visits and perform over 2100 deliveries annually. Their referral rate to a  
52 physician was only 3.2%. This underscores the fact that the midwives are primarily  
53 managing their patients<sup>1</sup> and emphasizes the importance of gaining their in-the-field  
54 perspective on obstetrical challenges in rural Uganda.  
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4 The rural midwives' self assessment of clinical management skills demonstrated scores  
5 ranging between "not at all comfortable" to "somewhat comfortable" in 9 of 11 (81.8%)  
6 selected diagnoses despite their mean 2.5 years of education and an additional 2.5 years  
7 of experience in the field. This is felt to be attributable to the lack of ultrasound in their  
8 training and practice. Ultrasound is generally required to diagnose all 11 conditions  
9 surveyed and has many other uses including dating the pregnancy, second trimester fetal  
10 screening and in labor and delivery to predict whether vaginal delivery will be  
11 successful.<sup>9-11</sup> The utility of ultrasound is key in timely diagnosis, which allows for labor  
12 management preparation, delivery route planning, and early appropriate referral of certain  
13 conditions, especially those that might otherwise be fatal. According to the data, fetal  
14 macrosomia was one of the least understood diagnoses. However, according to recent  
15 literature, diabetes and obesity in women of reproductive age is increasing in developing  
16 countries, including Uganda, leading to a rise in macrosomic births and adverse birth  
17 outcomes.<sup>12</sup> Antenatal ultrasound diagnosis of macrosomia and attendance at delivery by  
18 a midwife who is prepared for potential shoulder dystocia could dramatically decrease the  
19 morbidity and mortality of such deliveries. In the free text section of the survey, when  
20 asked to recall a case where ultrasound might have impacted patient outcome, one  
21 midwife wrote, "One mother never knew that she had placenta previa because she had  
22 not done ultrasound scan. She got some complications and she even lost her baby."  
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41 With respect to the critical issue of antenatal care rates, 7/12 (58%) of the midwives  
42 reported that women typically attend less than the recommended 4 ANC visits. This is  
43 consistent with prior literature where the majority (68%) of women received less than the  
44 recommended four ANC visits<sup>1</sup> and highlights the fact that low ANC attendance is still a  
45 problem in rural areas. The health facilities reported transportation as a major barrier to  
46 ANC attendance, which is consistent with prior literature.<sup>4,5</sup>  
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54 In addition to lack of transportation, several of the midwives reported lack of ultrasound  
55 was a barrier to women seeking ANC and an expectation that patient volume would  
56 increase with the introduction of imaging into routine care, which has been substantiated  
57 in other studies.<sup>12,13</sup> Reported anecdotal impressions from mothers at clinics where  
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4 ultrasound has been implemented suggest that the technology increases trust in the care  
5 provided and husbands were even more likely to accompany their wives to visits in order  
6 to see the scan.<sup>13</sup> This further increases opportunities for health education. Additionally,  
7 it has been shown that ultrasound implementation at antenatal visits increases the referral  
8 rate to obstetricians who can provide care for higher risk pregnancies, in one study, as  
9 high as a 41% rate.<sup>14</sup> If applied to the statistics provided by the midwives, that would  
10 mean an average of an additional 2-3 obstetrics referrals per midwife per month. The  
11 need for increased human resources is also supported by the 2006 World Health Report,  
12 which estimated that an additional 1.5 million health care workers would be needed in  
13 Africa to meet the health care demands.<sup>15</sup> In fact, 36 out of the 46 countries in Africa  
14 were identified as having a "critical shortage" of doctors, nurses and midwives.<sup>15</sup>  
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26 **Conclusion:**  
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30 The health facilities' perspectives are overall consistent with the literature in that due to a  
31 variety of barriers. Improvement of ANC rates and diagnostic capabilities through  
32 ultrasound will contribute toward reaching the Millennium Development Goal 4 and 5 of  
33 reducing childhood mortality and improving maternal health.<sup>16</sup> This study highlights the  
34 rural health center's viewpoint that ultrasound will attract patients to the health facilities  
35 for ANC, but also emphasizes their concern about how to handle increased patient  
36 volumes. The midwives' self-assessment revealed a complete absence of ultrasound  
37 training in midwifery education and significant knowledge deficits in the management of  
38 prenatal conditions primarily diagnosed with ultrasound. This information prompted that  
39 the midwives who were to receive ultrasound machines at their clinics not only receive  
40 extensive formal ultrasound training, but also a "Field Guide" with concise information  
41 on the key management points for each condition mentioned in the survey. Follow-up of  
42 this cohort of health facilities and midwives should be performed to assess the impact on  
43 ANC attendance rates, maternal and fetal mortality rates. The total cost for equipping a  
44 health facility and training a midwife on obstetrical ultrasound is \$6,888 for a powered  
45 facility and the cost rises to \$8,288 for a solar powered clinic for the additional solar  
46 panel requirement.  
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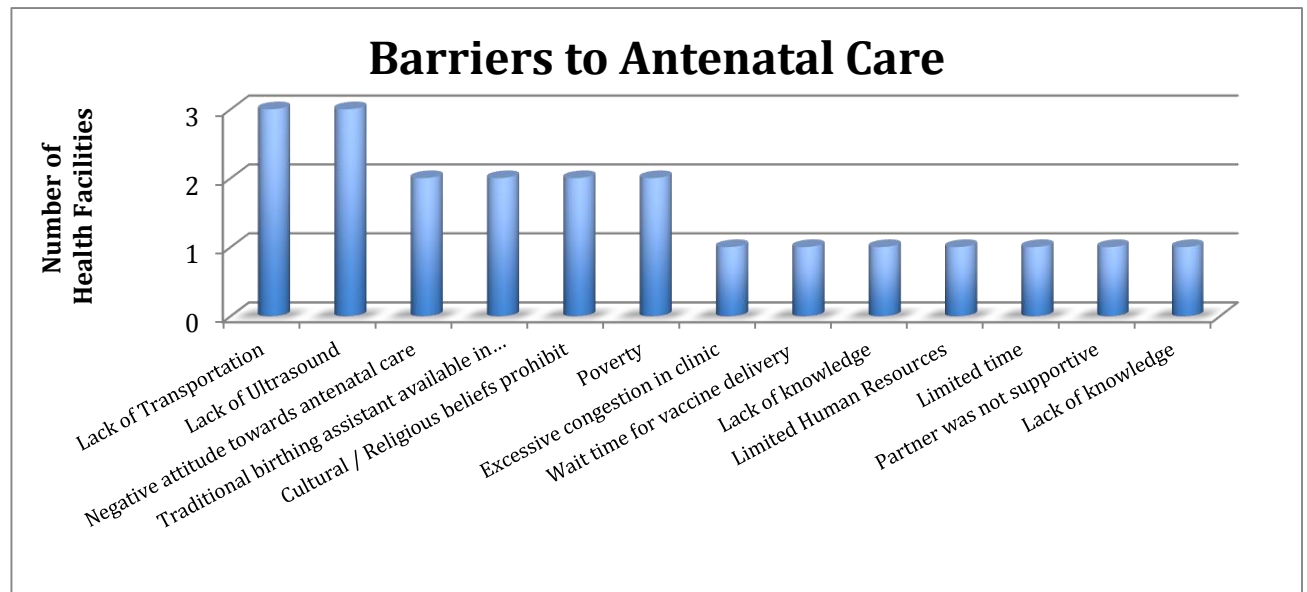
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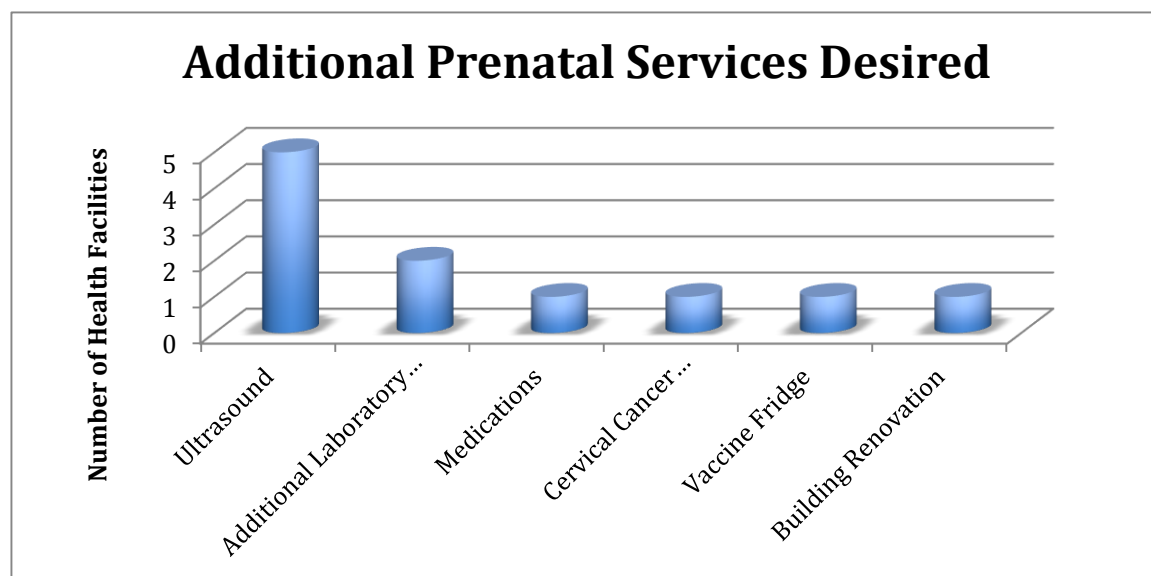
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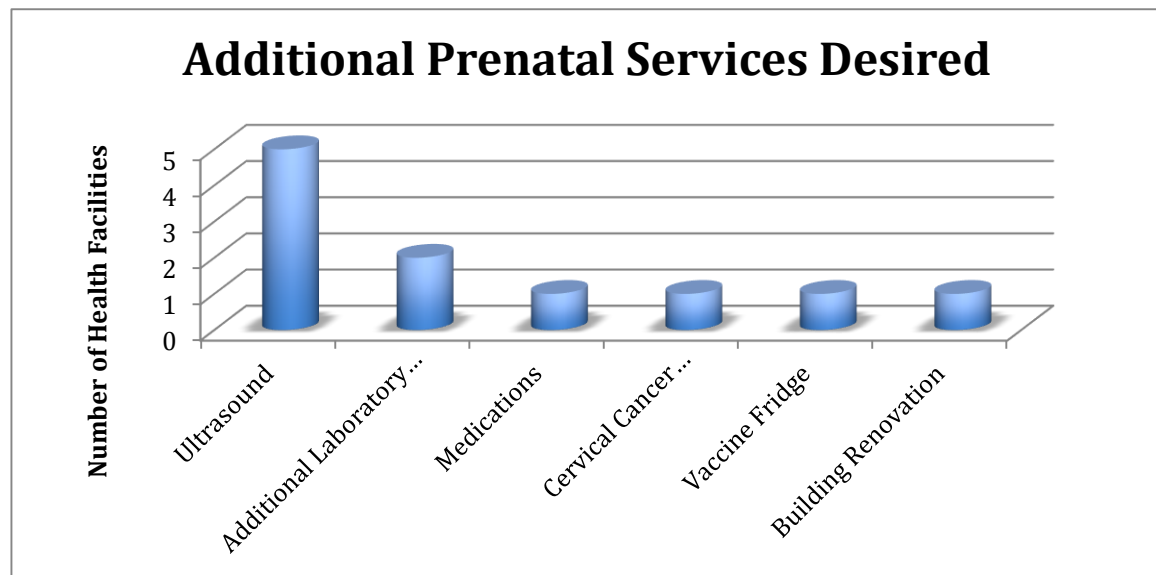
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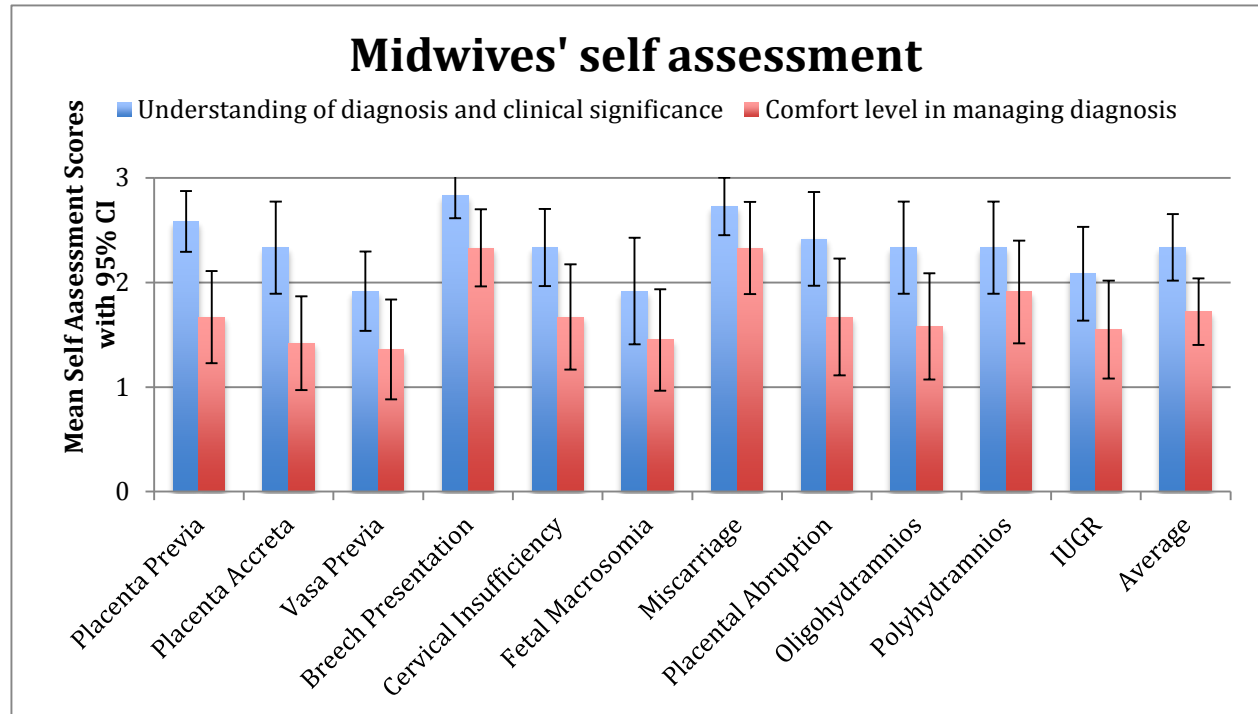
**Figure 1: Barriers to antenatal Care reported by 5 rural Ugandan health facilities.**



**Figure 2: Additional requested prenatal services by 5 rural Ugandan health facilities**



**Figure 3: Anticipated needs with new ultrasound machine at 5 rural Ugandan health facilities**



**Figure 4:** Response averages of 12 midwives using rating scale of 1 to 3. In the understanding of diagnosis and clinical significance, scores were as follows: 1 represented "I do not know what this diagnosis is"; 2 represented "I have a limited understanding"; 3 represented "I am very knowledgeable." Similarly, in the comfort level in managing the diagnosis, scores were as follows: 1 represented "not at all comfortable"; 2 represented "somewhat comfortable"; 3 represented "very comfortable."



No	Name of facility	Level	District
1	Bugiri Facility of the Kinkiizi (COU) Diocese	III	Kanungu
2	St. Stephen's Dispensary of the Namirembe (COU) Diocese	III	Kampala
3	Chrisco Butiru Facility of the Chrisco Church	IV	Manafwa
4	Nampunge Facility of the Church of God	III	Wakiso
5	J.O.Y. Hospice of the Deliverance Church	III	Manafwa
6	North Kigezi Facility of the North Nigezi (COU) Diocese	IV	Rukungiri
7	Boroboro Facility of the Lango (COU) Diocese	III	Lira
8	Kirongero Facility of the Church of God	III	Bugiri
9	St Luke Katiyi Facility of Madi West Nile (COU) Diocese	III	Arua
10	Rutaka Facility of the Muhabura (COU) District	III	Kisoro
11	Kihanga Facility of the Kigezi (COU) Diocese	III	Kabale
12	Padwot Midyere Facility of the Nebbi (COU) Diocese	III	Nebbi

**Table 1: Name, Health Center Level and District of 12 Antenatal Clinics. COU indicates Church of Uganda.**

Survey question	Statistical Analysis
How many years have you been practicing as a midwife? (in years)	Mean: 3.1 Median: 2.5 Range: 0.42 to 12.0
How long did it take you to complete your training as a midwife? (in years)	Mean: 2.6 Median: 2.5 Range: 0.5 to 4.0
Do you assist with vaginal deliveries? If yes, approximately how many babies do you help deliver in a month?	Mean: 15.1 Median: 11.0 Range: 0.0 to 60.0
Approximately how many women do you see each day for antenatal care?	Mean: 9.3 Median: 5.3 Range: 1.5 to 30.0
At approximately what gestational age do most women first come to clinic for antenatal care? (in wks)	Mean: 19.3 Median: 20 Range: 15.0 to 28.0
How many antenatal care appointments do most women attend? 1? 2? 3? 4 or more?	Mean: 3.1 Median: 3.3 Range: 1.5 to 4.0
Approximately how many women do you refer for an antenatal consultation with an OB doctor each month?	Mean: 6.5 Median: 2.5 Range: 0.5 to 50
Approximately how many women each month do you refer for a C-section during active labor?	Mean: 3.3 Median: 2.5 Range: 0.0 to 8.5
Approximately how many women each month	Mean: 1.6

do you refer for a C-section prior to active labor?	Median: 1.3 Range: 0.0 to 4.0
Approximately how many patients do you see each month that are HIV positive?	Mean: 9.8 Median: 4.8 Range: 0.5 to 65.0
Do you manage the care of newborns? If so approximately how many babies do you see in a week?	Mean: 4.0 Median: 3.5 Range: 0.0 to 12.5

**Table 2: Results from Questionnaire #2**