



## Article

## Barriers to uptake of antenatal maternal screening tests in Senegal



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## ABSTRACT

**Background:** Evidence exists that selective antenatal maternal screening tests contribute to the reduction of maternal morbidity and mortality. However, data are lacking on coverage with the complete set of recommended tests. The study aimed to identify barriers to uptake of the complete set of tests recommended by the Ministry of Health in Senegal.

**Methods:** Data were collected in communities, antenatal care (ANC) clinics and the laboratories of 11 public health care facilities across Senegal. Mixed-methods included ethnography (observations and informal conversations), in-depth interviews and workshops at the health facilities; structured interviews with 283 women receiving antenatal tests ("women in the lab"); in-depth interviews with 81 women in communities who were pregnant or had recently delivered ("community women").

**Results:** Only 13% of community women and 22% of women in the lab had received the complete set of tests. For various social, financial and antenatal care-related reasons 38% of community women who visited antenatal care facilities did not access a laboratory. The lowest test uptake was in women receiving antenatal care at health posts. Barriers at the laboratory level were the cost of the test, stock-outs of reagents, and broken equipment. Midwives were the main gatekeepers of the laboratory, not requesting (all) tests because of assumptions about women's financial problems and reliance on clinical symptoms.

**Conclusion:** In Senegal, recommended antenatal maternal screening tests are substantially underutilized. Efforts to increase test uptake should include accessible testing guidelines, reducing the cost of tests, raising awareness about the reasons for tests, and making the complete test set in point-of-care format accessible in peripheral health posts. National and international antenatal care policies and programs should facilitate access to maternal screening tests as a contribution to reducing maternal and infant morbidity and mortality.

## 1. Introduction

This paper focuses on barriers to the utilization of recommended maternal screening tests, an under-studied aspect of antenatal care. During fieldwork we regularly came across problems that could have been prevented if women had had routine antenatal diagnostic tests. For instance, during her first antenatal care (ANC) visit, a woman told the midwife she had experienced five subsequent miscarriages after having her first child. She was now receiving laboratory tests for the first time and appeared to have Rhesus factor-negative blood – explaining the miscarriages. If she had taken Serum Anti-D injections after her first delivery of a Rhesus positive baby, these miscarriages could have been prevented.

Besides checking the blood group and Rhesus-factor (BGR), other routine antenatal maternal screening tests have been proven to reduce maternal (and child) morbidity and mortality if followed by adequate management of the detected conditions, i.e. testing for proteinuria (PU) for risk of pre-eclampsia, and HIV and syphilis screening to prevent vertical transmission (Carroli, Rooney, & Villar, 2001; Di Mario et al., 2005). The estimated 2013 maternal mortality ratio in Senegal was 320 per 100,000 live births, which is a huge decline from the 530 in 1990, but still far from the millennium development goal of 133 for 2015 (World Health Organization, 2015). The Senegalese national guidelines on antenatal maternal tests adopted the five tests recommended by WHO (screening for PU, syphilis, and HIV, BGR determination, and hemoglo-

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bin concentration), and added screening for sickle cell anemia (SC) (Ministère de la Santé de l'Hygiène Publique et de la Prévention, 2014; Partnership for Maternal, Newborn and Child Health, 2006). The national guidelines prescribe that these six tests should be requested during the first ANC visit. Equipment and materials for the full antenatal screening panel are present in the laboratories hosted at health center level and above (as from mid-level) of the public health care system (managed by the Ministry of Health – MoH). Health centers, usually headed by a general physician, comprise hospitalization services and are located in district capitals. Generally, the more numerous lower level health posts that provide outpatient services and take uncomplicated deliveries, do not have laboratories but can perform HIV serology and PU screening as rapid point-of-care (POC) tests during ANC consultations. Hence, women seeking ANC services at health posts need to be referred to a laboratory for the complete set of six screening tests. Most health care services (including ANC) are provided through the public sector; the private and military facilities are concentrated in towns – 85% of which are in Dakar (Barnes, Bishop, & Cuellar, 2009; Tine, Faye, Nakhimovsky, & Hatt, 2014). To increase access to maternal care and improve maternal (and child) health, the Senegalese government implemented the Free Delivery and Cesarean Policy (FDCP) in 2005, entailing that women do not have to pay for delivery in health posts and health centers, and for cesarean sections in health centers and regional hospitals. Health facilities pre-finance these services and are reimbursed at the national level (Witter, Armar-Klemesu, & Dieng, 2008). However, ANC is not free, except for routine malaria prophylaxis, anti-tetanus vaccination and HIV test. In addition to the consultation and registration fee, women have to pay for medicines, laboratory diagnostic tests, and abdominal echography as requested by the ANC providers. Health facility management fixes prices within limits set by the MoH. Health insurance coverage is low in Senegal, although the government has been strategizing increased coverage since 2012. About 11% of the population is covered by mandatory schemes for employees of government or private companies, and 4% by voluntary subscription to community based or private health insurance schemes (Tine et al., 2014).

The objectives of the SociaLab study<sup>1</sup> were to gauge the uptake of the six recommended antenatal maternal screening tests and to identify and explain barriers to testing. ANC test uptake was defined as: (i) women's access to the laboratory; (ii) ANC providers' test requests and implementation in the case of POC tests; (iii) the laboratory carrying out the assays. The approach was interdisciplinary, and the study had a biomedical and an anthropological arm. This paper presents findings from the anthropological arm that focused on barriers on three different levels: community, ANC clinic and laboratory. We aimed to explain these barriers from the perspectives, living and working conditions of the main actors: the pregnant women, the ANC providers, and the laboratory staff. In the discussion we group the identified barriers in the health systems building blocks to guide our recommendations for interventions (World Health Organization, 2010).

### 1.1. Literature review

In our literature search on barriers to ANC test uptake – in Google Scholar, Cochrane library, and PubMed, using search words access, barriers, utilization, uptake, blood, antenatal care, tests, laboratory, and diagnostic – we did not find any papers addressing the complete set of recommended tests, only studies focusing on antenatal HIV or syphilis serology tests. For instance, identified barriers to uptake of syphilis testing at provider level are low motivation to request tests and poor organization of services. At community level barriers were found to be high cost, distance to the laboratory and low awareness of the seriousness of the health risks (Bocoum, Kouanda, & Zarowsky, 2014; Gloyd, Chai, & Mercer, 2001). The main barriers to ANC HIV testing identified relate to

health staff not proposing the test, women's fear of being seropositive, and having to obtain husband's permission to be tested (Kwapong, Boateng, Agyei-Baffour, & Addy, 2014; Larsson et al., 2012). Demographic and Household Surveys (DHS) usually measure uptake of urine and blood sampling – not specifying whether and which tests were carried out on the specimens. The Senegal DHS 2010–2011 report gives 85% for urine- and 76% for blood sampling among women attending ANC (Agence Nationale de la Statistique et ICF International, 2012).

We suspected that findings from anthropological studies on barriers to giving blood and accessing ANC in sub-Saharan Africa may be relevant to barriers to antenatal test uptake. Several studies on barriers to giving blood found that people object because they believe that it takes away life essence, or that the blood is sold or used for witchcraft (Fairhead, Leach, & Small, 2006; Geissler, 2005; Geissler & Pool, 2006; Stadler & Saethre, 2010). Fairhead et al. (2006) note that these beliefs arise especially around medical research requiring blood collection, and may apply less to routine screening tests. Commonly identified barriers for women to access ANC are distance to health facilities, disrespectful and abusive staff, financial hardship (Finlayson & Downe, 2013; Pell et al., 2013), high indirect costs for transportation, physical burden of travel, and difficulty accessing cash from husbands or family members (Pell et al., 2013). Studies in two of our rural study sites show that the cost of prescriptions and transportation and husband's lack of support are major reasons for women not completing the recommended four ANC visits (Harlow, 2007; Ndiaye, Tal, Diediou, Dieye, & Dione, 2005). Other studies in Senegal report that unequal gender relations have important influence on women's health-seeking behaviors, with women having to be submissive to male authority and husbands not always prioritizing health care (Foley, 2001, 2010; Franckel & Lalou, 2009; Forsyth, 2015; Guerin, 2008).

We also suspected that non-referral by ANC providers might be a barrier to women's access to laboratory services. Public-health studies in sub-Saharan Africa blame the general underutilization of laboratory services partly to clinical decisions unsupported by laboratory testing. These studies found that not using laboratory services may be due to clinicians' high workload leaving no time to wait for test results, and clinicians' lack of trust in the reliability and validity of test results (Petti, Polage, Quinn, Ronald, & Sande, 2006; Okeke, 2011).

## 2. Material and methods

### 2.1. Sampling of study sites and study populations

Study sites were located in and around three hospitals and eight health centers across Senegal; three sites in Dakar and eight outside Dakar (“in the region”). Eleven of a total of 96 public health facilities hosting a laboratory (the intermediate tiers of the health care delivery system), were purposefully sampled to cover the 14 administrative regions.

At the health facilities, study populations included all ANC and laboratory personnel, and other relevant staff (including directors and social workers). At community/client level the two study populations comprised (i) in communities: pregnant women and women who had delivered in the previous six months – later referred as ‘community women’ and (ii) in the laboratory: pregnant women who came for testing – later referred as ‘women in the lab’. Community women (81) were recruited by the local interpreters from across the facilities' catchment areas. In the laboratories, we recruited as many women as possible coming for testing to the laboratory totaling 283 women in the lab (Table 1).

### 2.2. Data collection and methods

Data were collected from February 2013 to July 2014. During the initial Phase One in four facilities, the fieldwork took six weeks to explore the factors influencing utilization and non-utilization of

<sup>1</sup> <http://aighd.org/project/socialab>.

**Table 1**  
Data collection methods, sample size, by study population and by level.

Data collection methods	Community	ANC clinic	Laboratory	Facility
<i>Ethnography</i>		11	11	11
<i>In-depth interviews</i>	81 community women <sup>a</sup>	11 staff	11 staff	8 staff
<i>Structured interviews</i>	283 women in the lab			
<i>Assignments in workshops</i>		-----125 staff of 8 facilities <sup>b</sup> -----		

<sup>a</sup> In Phase One.

<sup>b</sup> one facility of Phase One, all seven of Phase Two.

maternal screening, terminology, sensitivities in phrasing questions and approaching people, and key stakeholders. Phase Two was conducted in the seven remaining sites for a duration of one week per site.

In health facilities, focusing on the ANC clinic and the laboratory, the main data collection method was ethnography, entailing participant observation, involving the observation of daily routines and informal conversations with staff and clients. The focus was on the organization and practice of services, work conditions, interactions, test requests, and available assays. In addition, in-depth interviews (IDI) were conducted with in-charges (IC) or senior staff of ANC and laboratories, and medical directors, health committee members, and social workers. During these IDIs we discussed the material and human resources in the facility and specifically for ANC and laboratory, the coordination between ANC and laboratory, their view of ANC and laboratory services' quality and barriers to utilization of ANC testing. In Phase Two a four-hour workshop was organized in each facility with all laboratory and maternity staff, and other relevant staff, after piloting this method in the last health facility of Phase One. Participants worked in groups to identify and discuss the local barriers to test uptake at community, ANC and laboratory level, and to formulate area-specific solutions.

At community/client level, in Phase One, we conducted 1–2 hour IDIs with women in their homes, often with family members participating – assisted by a local interpreter. These interviews solicited personal experiences with ANC and tests and information on their socio-demographic and economic background including family composition, and living conditions – the latter were also observed. The women in the lab were interviewed using a structured interview tool. These provided quantitative information on test requests by type of ANC provider, test execution, decision making on accessing the laboratory including paying for services and transportation, as well as information on socio-demographic and economic characteristics of women, and their experiences with services (Table 1).

### 2.3. Data handling and analysis

Daily fieldwork reports were written and the audio-recorded IDIs and workshop group-presentations were transcribed. These were analyzed using QSR International's NVivo 10 software. The thematic data analysis was ongoing during the fieldwork. Starting from a list of themes, developed after the first weeks of fieldwork, the upcoming themes and concepts were added and explored in subsequent observations, conversations and IDIs.

The data collected through the structured interviews were entered and analyzed in EpiData software. These data mainly serve descriptive purposes; statistical analysis was only carried out for Table 4 using Stata 12.

### 2.4. Ethical issues

Ethical clearance for the SociaLab proposal SEN12/09 was granted by the *Comité National d'Ethique pour la Recherche en Santé* in Senegal. All individual participants were informed about the nature

and purpose of the study and gave oral consent. In the community all women we approached cooperated in the interview, although two did not agree to audio-recording. At the laboratory three women refused to be interviewed.

## 3. Results

### 3.1. Community level: Why some women do not access the laboratory

#### 3.1.1. Background and contexts of the women

Age range of the participating women was broad, with women starting reproduction in their teens and continuing till over 40. Over 40% of women had received no formal education at all (Table 2), which is lower than the DHS 2010-11 figures of 58% of 15–49 years-old women without education (L'Agence Nationale de la Statistique et ICF International, 2012). Almost all participants were married, the majority in a monogamous marriage, with around 75% living in extended families, which is the norm in Senegal.

Participants in the study explained that extended families usually consist of parents, unmarried children, and married sons with their wives and children. People share a house, eat together and assist one another financially. Daughters-in-law are responsible for all household chores, including cooking for the whole family, in rotation with other daughters-in-law. When it is her turn to cook, the husband gives his wife a daily allowance for food – *dépense quotidienne*. The amount is usually meager, because most husbands do not have an adequate

**Table 2**  
Characteristics of sub-population of women.

Characteristics		Community women (N=81)	Women in the lab (N=283)
Age	Age range (years)	14–40	15–48
	Mean age (years)	28.7	25.2
Marital status	Married	93%	96%
	Monogamy	88%	78%
	Polygyny	12%	22%
Pregnancy status	Single	7%	4%
	Pregnant	84%	100%
Status of # ANC visits	Delivered	16%	
	0	5%	–
	1	9%	63%
	2	21%	27%
	3	35%	7%
	4	15%	3%
	5 or more	10%	–
No information	6%	–	
Household situation	Extended family	74%	80%
	Nuclear family	26%	20%
Education level	No education	41%	45%
	Primary (one year - finished)	33%	21%
	College and Higher education	26%	34%

income (husbands of 70% of community women and 79% of women in the lab). It is considered shameful for a couple if the husband cannot provide for his wife and children, including paying for health services. When we asked who paid for transport or laboratory tests, all married women said “my husband”, and many specified: “that is the normal thing”. The shame of a husband or boyfriend not providing was a reason for several community women not to access services. A five months-pregnant 26 year-old woman told us: “My mother said that I should go to the hospital [for ANC] and that she would pay – but I did not want that. I do not want to ‘tire’ [burden] her. My husband has to pay for it”. (Her husband was an apprentice mechanic without a salary).

Forty-three percent of the women (both community women and women in the lab) increased the amount of the *dépense quotidienne*, mostly by engaging in small business such as street vending. Others did not get permission from their husbands to earn money, or lacked seed-money to start a business. Visiting the community women in their houses – observing housing conditions and possessions and asking about source of income and its sufficiency for basic needs – enabled a crude classification of household economic status in three groups. Thirty percent of community women lived in absolute poverty, i.e. we observed extremely poor housing and only few possessions, and women recounted low or no income and a daily struggle for sufficient food. Another 30% lived in somewhat less poor conditions and reported to have enough money for daily food, but to have financial difficulties to pay for other basic needs, such as health care. The remaining 40% lived in adequate housing and told to have sufficient income to pay for basic needs. Answers to questions about money illustrated women's financial predicaments. One woman said: “I used to sell sugar and oil, but I had to eat the money from the business, because my husband was not around.” Another woman commented: “Women in Senegal are tired. Everything is expensive; if your husband has no money – you just stay [you cannot do anything].”

The women we interviewed and family members we had informal conversations with valued ANC. This is also clear from the finding that 95% of community women had made at least one ANC visit. (Besides the 5-months pregnant women referred to above, the other two pregnant women were only two months pregnant and said they would start ANC later). Our findings concur with national DHS 2010–2011 statistics that show 93% coverage for one ANC visit (L'Agence Nationale de la Statistique et ICF International, 2012). Almost half (48%) of the community women attended ANC in health posts, reportedly because of cheaper services and transportation costs, a personal relation with the health staff, or shorter waiting times. The other community women received ANC in a health center (29%), public hospital (8%), private clinic (10%), or a combination of providers (5%) (Table 3).

### 3.1.2. Women's access to the laboratory

The uptake of ANC tests requires the woman to take the test request from the ANC provider to a laboratory and pay for the tests. Most women recounted that after their ANC visit they showed the test request (and other prescriptions) to their husbands or mothers-in-law

(if the husband was absent), and asked for money. How easy it was to get money depended partly on “what he [the husband] has in his pocket”, women said. Most women did not know how much they should request or what precisely they were requesting money for: only 27% of women in the lab said they were informed about the price and only 22% about the reasons for the tests. Since many women and men in Senegal are illiterate, they cannot read the test request. Besides raising money for the tests, women have to find money for transportation to the laboratory.

Sixty-two percent of the 77 community women who had ANC accessed a laboratory. Table 3 shows the huge range in laboratory access by ANC provider level with the by far lowest access among women who attended ANC at health posts (41%).

### 3.1.3. Barriers to accessing a laboratory

**3.1.3.1. No request.** The most reported reason why 29 community women did not access the laboratory was not having received a test request. This was mentioned by 17 participants, six of them specifying that they would not have had the money anyway. Some women recounted how they chose facilities for ANC where they knew that the midwife would be receptive to their financial problems and would not give expensive prescriptions for medicines and requests for tests or echography. A woman in Richard Toll who was about to deliver said: “I explained to the midwife that I didn't have money. The midwife understood and did not request any tests yet, but said that maybe I could do the tests later.”

**3.1.3.2. No money.** Financial problems were explicitly reported as a barrier by 10 of the 29 community women who did not have tests in the laboratory. Access to the laboratory dramatically decreased with the standard of living: only 33% of women living in absolute poverty accessed the laboratory as opposed to 67% of women with fewer financial problems and 73% of women without financial problems. When we asked whether she would go to the laboratory for the tests, a woman in Tambacounda said: “I do not know. I have no money at the moment. My husband helps but now he cannot work. Poverty rules here.” Financial problems do not always present an absolute barrier if women are convinced of the importance of tests, as the following story of a woman in Dakar illustrates: “I did not have much money, so I went to all the places where the midwife had told me I could do the tests. I did the tests in GD [health center], which was the cheapest. In GD it was 10,500 CFA [FCFA], in F [hospital] 32,500 CFA, in D [hospital] 40,000 CFA and in GK [health center] 23,000 CFA.” (1000 FCFA = ± € 1.50).

Although the women in the lab had managed to find money, this had not been easy for 61% of them. A common reason for cash problems was that husbands were not around: many men migrate to (other) towns or abroad in search of work. Only 9% of women in the lab had some of the costs covered by health insurance.

### 3.2. ANC-clinic level: Why some midwives do not request all tests

In hospitals and health centers ANC services are provided by registered midwives and gynecologists. Not all health centers had a gynecologist, and if they did they were only consulted by women with pregnancies at risk, or who could afford a specialist consultation. In health posts, ANC is provided by a midwife, a nurse or a *matrone* – trained community volunteers who assist in the maternity section and provide primary maternal and child health care in health posts. For convenience we will talk about “midwives” when referring to ANC providers, because they constituted the majority ANC providers in our study (95%).

**Table 3**

Community women's access to the laboratory, by place for ANC.

ANC provider	N	Accessed laboratory n (%)	Not accessed laboratory n (%)
Public hospital	6	4 <sup>a</sup>	2 <sup>a</sup>
Health center	22	20 (91%)	2 (9%)
Health post	37	15 (41%)	22 (59%)
Private clinic	8	6 <sup>a</sup>	2 <sup>a</sup>
Mix	4	3 <sup>a</sup>	1 <sup>a</sup>
All	77	48 (62%)	29 (38%)

<sup>a</sup> No percentages are shown for denominators below 10

**Table 4**  
Tests requested/done as POC, among women in the lab, by place for ANC.

Place for ANC	N	BGR n (%)	SC n (%)	Syphilis n (%)	HIV n (%)	Hb n (%)	PU n (%)	Complete <sup>a</sup> n (%)
Public hospital	39	30 (77%)	29 (74%)	29 (74%)	34 (89%)	31 (80%)	23 (59%)	5 (13%)
Health center	148	123 (83%)	122 (82%)	140 (95%)	123 (83%)	87 (59%)	101 (68%)	56 (38%)
Health post	83	79 (95%)	73 (88%)	80 (96%)	48 (58%)	48 (58%)	50 (60%)	13 (16%)
Private clinic	13	9 (69%)	9 (69%)	12 (92%)	9 (69%)	10 (77%)	7 (54%)	3 (23%)
All	283	241 (85%)	233 (82%)	261 (92%)	214 (76%)	176 (62%)	181 (64%)	77 (27%)

<sup>a</sup> Taking into consideration POC tests during ANC consultation and known BGR and SC status.

### 3.2.1. Routines in the ANC clinic

Observations showed that when midwives start their consultations, around 9 am, there are usually some 25 to 40 women in the waiting area. Health facilities differed in their ability to streamline the process and reduce waiting times. This also depended on the number of consultation rooms and staff, which ranged from one to four and two to five respectively. Women generally complained about the late start and long waiting times up to five hours. However, the midwives explained that they needed to have breakfast first – normally taken at the place of work – so that they could continue non-stop until they finished work at around 2 pm.

Guidelines dictate that the many procedures during a first ANC consultation include recording personal and reproductive history, physical examination, taking vital signs, counseling for HIV and, if applicable, executing POC tests for HIV and PU. POC HIV testing was actually done in eight facilities, while PU tests were supposed to be done in seven facilities but were in fact available and routinely executed only in three. Observed reasons for not doing the PU test were the unavailability of the test dipsticks or women being unable to pay (between 200 and 500 FCFA – € 0.30 and 0.75). Midwives have to record all information in the woman's take-home booklet and the ANC register, to explain all the procedures to the women, to write a prescription for prophylactic treatment against anemia and malaria, and to request laboratory screening tests and abdominal echography. The test request should ideally be accompanied by clear explanation of the reason for the test and practical information about testing (opening hours of the laboratory, price of tests, when and where to return with the results). Midwives said they usually did not explain much due to lack of time, but also because "women would not understand anyway: many women in this area are illiterate". Other reasons for not explaining were that women might refuse the test (for HIV) and a language barrier, with many women, especially in the regions, only speaking local languages.

This first ANC consultation should take at least half an hour. Subsequent ANC visits can be shorter, since fewer forms have to be filled in and routine tests are requested only at the first consultation. In practice, however, midwives generally spent 10–15 min per ANC client, with little time to explain procedures and prescriptions. During the ANC hours, midwives also consulted for post-natal care, family planning, general reproductive health, and supervised *matrones* in the maternity who attend to the uncomplicated deliveries. In eight clinics, *matrones* or other assistants recorded the vital signs of women, and/or executed POC tests if applicable, in order to reduce midwives' workload.

In addition to the heavy workload, midwives are confronted to the shortage of furniture, equipment and consumables in most facilities. The work environment is poor with more than half the midwives outside Dakar working in inconvenient small offices, without air conditioning or adequate ventilation, in temperatures over 35 °C. One of the older midwives in Dakar told that she worked in Tambacounda – one of the study sites – for a year but that "I left because I just could not stand the heat". To make things worse, midwives are poorly paid. In the study facilities, 22% of midwives worked without any salary, in the hope of eventually being hired by the

public sector as a civil servant or by the health committee as a contract worker.

### 3.2.2. Test requests by the midwives

Only 27% of the women in the lab had received a complete test request from the midwife. With this figure we took note of already known BGR and SC status and the possible POC tests during ANC consultation (67% of HIV and 71% of PU tests were performed as POC test in the ANC clinic). Table 4 shows that complete test requests were more frequently given to women consulting in health centers (38%) compared to other places for ANC (13 - 38%). This difference was statistically significant ( $p < 0.001$ ; Fisher's exact test).

When analyzing the individual tests, there is a lower coverage for hemoglobin concentration test (Hb) and PU. In health posts HIV testing was the least done or requested.

### 3.2.3. Barriers to test requests

In the workshops and informal conversations, midwives acknowledged that they do not always request tests or all six tests. The following is a summary of the main reasons they gave.

**3.2.3.1. The assumption that women cannot pay.** Forty-three percent of midwives in the workshops said they do not request tests when they think that women cannot afford them, in which case, they prioritize the tests that they judge most important, skip the most expensive ones (Hb), or do not request any tests. One midwife reasoned: "It depends on how I estimate the means of the woman and her physical state. When their husband is a horse cart driver, [I assume] they have little money. If I request too many tests, they might not do any."

**3.2.3.2. Lack of guidelines.** Mainly younger midwives reported missing guidelines on ANC tests. Only in one facility did supervisors provide guidance by supplying midwives with a pre-printed request form. Confusing for midwives is that tests featured in the ANC register do not completely concur with the tests recommended by the MoH: Hb concentration is lacking, while glycaemia featured. This may explain why midwives normally requested glycaemia (for 83% of women in the lab) and why Hb requests were fewer.

**3.2.3.3. Forgetting and insufficient human resources.** Midwives recognized that sometimes they simply forget to request tests. This happened regularly when observing the consultations during fieldwork. Although negligence plays a role, we understand that working long hours in understaffed clinics, sometimes right through a night-duty in the maternity, contributes to this situation.

**3.2.3.4. Knowing that assays are not available in the facility's laboratory.** If midwives knew that specific equipment was dysfunctional or reagents were unavailable, they did not request those specific tests. In one facility midwives filled in two request forms, one

for the tests available within the facility's laboratory and the other for another laboratory. Midwives realized that this compromises the chance that women get a complete set of tests.

**3.2.3.5. Valuing clinical observations above laboratory diagnostics and relying on prophylactics.** Some midwives said to rely on their clinical diagnosis, with no need to request PU or Hb concentration to identify risk of pre-eclampsia or anemia. Since all women receive iron tablets many midwives thought this would prevent severe anemia, making the expensive Hb concentration test unnecessary. Midwives who worked as nurses before their midwifery training in particular relied on clinical diagnoses. One of them clarified: “I am first nurse and then midwife, so I rely on interrogating and examining the woman and I listen to her complaints: headache, fever, abdominal pain, vaginal discharge etc. Then I have an idea what is wrong and sometimes I know for sure. .... I may already prescribe [a treatment].”

### 3.3. Laboratory level: Why test requests are not all executed

#### 3.3.1. Routines in the laboratory

Opening hours for specimen collection normally range between 8 and 11 am. Three rural laboratories collected samples the whole morning, acknowledging transportation problems for clients travelling from far. One laboratory specifically extended opening hours to coincide with ANC clinic hours.

Like any other client, each woman coming for ANC testing hands her request and payment receipt to a laboratory staff member. The range in prices for tests was remarkable, with the highest sometimes twice as much as the lowest. The prices for a complete package ranged from 6,500 to 11,500 FCFA with a mean of 9063 FCFA (€13.59). The management of three facilities had reduced the price for a complete ANC test package, which saved women around 2000 FCFA (€3).

After handing the request, the woman returns to the waiting area for a period not exceeding one hour. She is then called for the blood draw which normally takes just a few minutes and she is given a container for a urine sample if applicable. After specimen collection, laboratory staff gives a date and time for collecting test results. The test results were returned later the same day at 1 or 3 pm for four laboratories and on the following day in the seven other laboratories. Three of the latter had a special same-day fast result-return procedure for women living far away, who usually had their ANC at peripheral health posts.

All ANC assays are relatively simple procedures, feasible by most trained laboratory assistants. The tests require a blood count machine (for the Hb count); a microscope (for SC test); consumables, including tubes, syringes, gloves, containers, slides, test-kits and reagents, and utilities including water and electricity. Assay procedures started around 10 am and finished around 1 pm.

#### 3.3.2. Executing antenatal screening tests

Only about one-fifth of women who accessed the laboratory had a complete set of tests. Coverage rates for women receiving individual tests and the complete set were similar for the community women who accessed the laboratory and women in the lab, which suggests that the findings are representative for women in the study locations. PU and Hb count had the lowest coverage rates and the syphilis test had the highest, irrespective of the sub-population studied. Differences were in HIV test coverage, which was lower among women in the lab, whereas PU coverage was lower among community women (Table 5).

Considering that not all community women accessed a laboratory, as explained in 3.1.3., we estimate that only 13% of all 77 community women who attended ANC received a complete set of tests (assuming

that the complete-test coverage among the 19 women we do not have information for is 21% as well).

Comparing the findings of Table 4 (test requests) and 5 (tests executed) we see that because of barriers at laboratory level, the coverage with a complete set of screening tests among women in the lab is reduced from 27% to 22%.

#### 3.3.3. Barriers to executing requested tests

All laboratories visited were adequately equipped and staff capable of performing the whole panel of antenatal tests. However, there were several reasons why all tests requested could not be executed. These barriers, elaborated below, were identified by staff in interviews and workshops, reported by women, and observed during fieldwork.

**3.3.3.1. Reagent stock-out and broken equipment.** In eight facilities not all assays could be carried out during the fieldwork period due to intermittent reagent stock-out or broken equipment, mostly the blood-count machine. Women had to be referred to other laboratories or asked to return another day, with the risk of not having a complete set of requested tests executed. The reasons for these problems were difficult to ascertain, with different stakeholders pointing accusing fingers at others. During fieldwork there were delayed orders from the laboratory's in-charge, other spending priorities by the management, or suppliers who did not deliver.

**3.3.3.2. Price.** Price was sometimes a barrier to the execution of tests. Some women had to return home without having tests or having selected only a few tests from those requested because they had not brought sufficient money.

**3.3.3.3. Inconvenient opening hours.** Opening hours for specimen collection and return of test results were often inconvenient for women and not coordinated with ANC opening hours. Women in most laboratories were not attended to when they came after opening hours. This problem was observed to be especially urgent in a laboratory that set these hours early, from 6.30 to 8.30 am [a heated point of debate between midwives and laboratory staff during the workshop]. Some women said they came late because they had struggled to find transport or were not informed about the opening hours. Other women had consulted the midwife or underwent abdominal echography, before presenting (too late) to the laboratory.

**Table 5**  
Screening tests received, by sub-population of women.

Tests	Women in the lab (N=283) n (%)	Community women (N=29) <sup>a</sup> n (%)
BGR	241 (85%)	23 (79%)
SC	233 (82%)	24 (83%)
Syphilis	261 (92%)	26 (90%)
HIV	212 (76%)	25 (86%)
PU	181 (64%)	13 (45%)
Hb	161 (57%)	16 (55%)
Complete <sup>b</sup>	62 (22%)	6 (21%)

<sup>a</sup> From the 48 community women who accessed the laboratory, we only know from 29 women the individual tests received; 19 did not have access to their test requests or results that were kept by their husbands who were not around.

<sup>b</sup> Taking into consideration POC tests and known BGR and SC status.

## 4. Discussion

### 4.1. Barriers to uptake of antenatal maternal screening tests

The study findings show that ANC maternal screening tests are underutilized, with only 13% of community women and 22% of women who accessed the laboratory receiving a complete set of tests. This confirms findings in the literature on the under-utilization of medical laboratories in sub-Saharan Africa (Petti et al., 2006; Okeke, 2011). The qualitative methods facilitated understanding of the multi-level barriers from the perspectives of those involved. These interrelated barriers can be grouped according to the WHO's health system's building blocks, as explained below.

#### 4.1.1. Health care financing

The high price of tests and the need for multiple trips, in combination with poverty constitute the major barrier to test uptake. The price of a complete set of tests represents 10–35% of a moderate monthly salary and much more for the majority of people without regular income. The study findings thus confirm evidence in the literature that financial problems are general barriers to accessing care (Bocoum et al., 2014; Finlayson & Downe, 2013; Gloyd et al., 2001; Harlow, 2007; Ndiaye et al., 2005; Pell et al., 2013). The fact that there was such a huge range in prices for the same tests showed that not all health facilities prioritized affordability. This could be explained by the financial difficulty faced by health facilities in the context of national directives entailing increasing the number of free-to-client health services (e.g. for under-fives, the elderly, delivery, and cesarean section). Paid laboratory services remain one of the main direct sources of revenue.

#### 4.1.2. Infrastructure and medical equipment

The complete set of the six ANC screening tests is only available from the health center level and above. This presents a major barrier to access, because most women attend ANC in health posts close to their homes. Although laboratories in Senegal are generally equipped and staff trained, the intermittent stock-out of reagents and breakdown of machines pose barriers to uptake of ANC testing. In a way it is a waste of resources to use a blood count machine for hemoglobin concentration only, whereas assays are available that only measure hemoglobin. In the ANC clinics, lack of equipment and supplies and poor work spaces for midwives are not direct barriers to test uptake (except for lack of POC tests), but indirectly they contribute to incomplete tests requests through midwives' fatigue and poor motivation. The finding that HIV testing was relatively low in health posts was disappointing because HIV testing has been decentralized to health post-level and all health posts should have HIV test-kits.

#### 4.1.3. Workforce, services delivery, and governance

Midwives are the gatekeepers to the laboratory. A main barrier for test uptake is midwives not giving women a request. Findings confirm literature on the under-utilization of laboratories because some midwives prefer their clinical diagnosis rather than diagnostic tests results (Okeke, 2011; Petti et al., 2006). Contrary to the literature that identified underutilization because of lack of trust in quality of the laboratory, midwives did not report they mistrusted the quality of laboratory tests but believed that some were an unnecessary expense since prophylactic treatments are provided anyway. From the interviews with community women we can deduce that midwives, especially those in health posts, are embedded in the community and feel obliged to "help" women by not requesting tests.

The coordination of service delivery between ANC clinic and laboratory was weak, which caused access problems. Although usually a lot of personal contact happens between health staff of different sections – as generally Senegalese people are very social and consider their colleagues family – there was little professional contact and

alignment of services in most health facilities. If there was any alignment of ANC and laboratory opening hours and facilitation of access to the laboratory, for instance by reducing the price and giving results the same day, it was not because of institutional rules but because the heads of ANC and laboratory sections were motivated to facilitate uptake of testing for women.

Generally, poor staff attitude was not mentioned as a barrier to women accessing tests (and ANC), whereas this is argued in the literature on ANC access (Finlayson & Downe, 2013; Pell et al., 2013). Only one woman in Dakar said she decided against going to a specific laboratory because staff "were too talkative about results [no confidentiality]".

#### 4.1.4. Community

Women would like to follow midwives' prescriptions, but unequal gender relations form a barrier to accessing tests, as also reported in the literature on health care access (Foley, 2001, 2010; Forsyth, 2015; Franckel & Lalou, 2009; Guerin, 2008). The majority of women depend financially and in their decision making on husbands. Women have difficulty convincing their husbands to pay for tests when they do not know the reasons for the tests. Financial problems are exacerbated by other factors, such as the shame that prevents women from accepting financial help from their own family members if their husbands do not give them money.

Some of the barriers to giving blood and ANC access as identified in the literature did not stand out in access to tests. Participants did not have culturally motivated objections to giving blood and did not mistrust ANC and laboratory services as found in other studies (Fairhead et al., 2006; Geissler, 2005; Stadler and Saethre, 2010). The Senegalese government has made maternity care available at peripheral level and has successfully promoted ANC and facility-based delivery as the norm that most women want to adhere to. The fact that sampled blood is used for routine screening and women get the test results on a piece of paper with their name takes away suspicion about abuse by health staff (Fairhead et al., 2006).

## 4.2. Recommendations

Specific recommendations to increase ANC testing uptake are based on those given by health staff in workshops and promising practices observed during fieldwork. These should be combined in a package addressing health care financing, policy (better guidelines and tests), organization of the work, including an improved deployment of antenatal POC testing options, support of human resources, and education of the community.

To reduce the price of tests, health facility management could introduce an antenatal maternal screening test package at the minimal price level set by the MoH. Midwives should not consider financial means of women, but always request the complete set of tests; they could involve the facility's social assistant for support if a woman is unable to pay and also if a Rhesus factor-negative woman needs Serum Anti-D (expensive at ± €75).

To stimulate demand and uptake, ANC providers should better communicate the importance of antenatal tests and inform ANC clients about the price and the conditions. Recognizing that gender norms are difficult to change overnight, health education on tests should be also given in the community and addressed to both men and women in order that husbands prioritize paying for testing. Midwives' argument that illiterate people cannot understand was refuted during fieldwork when women and men were able to repeat the explanations given by the research team – most of them being very interested to hear what the various tests were for.

To facilitate access in peripheral areas, we recommend that the complete set of antenatal maternal tests is decentralized to health posts. How this might be organized, safeguarding test quality, is a matter for discussions and collaboration between the MoH's

Directorate of Reproductive Health and the Directorate of Laboratories. Some initiatives already exist at local level: there are health posts with mini-laboratories supervised by district health center laboratories and district mobile laboratories that visit peripheral health posts.

Interventions at health facility level need national support concerning clear and accessible guidelines on antenatal maternal testing, financial support for equipment and supplies, and recruitment of staff to facilities with severe staff shortage, offering them a hardship allowance. The MoH could lower the minimum and maximum assay prices or subsidize – assisted by international donors – all antenatal maternal tests as is already the case for HIV and planned for antenatal syphilis screening in 2016.

#### 4.3. Reflections on study limitations

We believe this paper gives a valid account of the conditions for women in communities, for service providers in the ANC clinics and laboratories, and of the barriers for the uptake of ANC tests in Senegalese health facilities. The study limitations relate to the quantitative data from community women on their specific tests. First, we could not get this information from all women because the papers were kept by the absent husband (and we had no chance to revisit), and second, the statistics are based on a small sample. Because of lack of time and funds we were unable to hold IDIs with women in the communities around the health facilities of Phase 2. Another limitation is that we did not follow women until their delivery, thus missing women who might have had their tests (request) in a later stage of their pregnancy – even if the recommendations are to have them after the first ANC visit. However, we believe this flaw in design does not bias the findings, because from the women in the lab we know that most women (76%) have their tests request given after their first ANC visit, and another 19% after their second visit. Data from the 15 community women who had already delivered show that most women (9) do not finish the recommended four ANC visits – confirming the 50% coverage with four ANC visits of DHS data (Agence Nationale de la Statistique et ICF International, 2012); 13 of the 15 had tests in a laboratory; only one out of the six women whom we have specific test information on, had a complete set of tests.

#### 5. Conclusions

In Senegal, antenatal maternal screening tests appear not to be a priority for health staff and community alike. The fact that this study – as far as we know – is the only one on coverage, service-delivery, and barriers related to the WHO recommended antenatal maternal screening tests, makes the findings relevant beyond Senegal. It gives an indication to (international) ANC policy and program makers, and researchers to pay more attention to antenatal maternal screening tests, which are supposed to be an integral part of quality ANC. Evidence exists on the effectiveness of specific maternal screening tests in identifying maternal conditions that may jeopardize maternal and child health if remain untreated. However, evidence has to be gathered on the multi-level uptake barriers in order that country-specific interventions can be designed to increase uptake. We would like to see policies and programs aim at making the full set of ANC tests widely accessible, rather than focusing on one or two tests, i.e. HIV and syphilis screening. The ongoing follow-up of the SocialLab study in Senegal is to collaborate with the MoH and other stakeholders to design and implement interventions to increase uptake of recommended antenatal maternal screening tests – recognizing that utilization of these tests contributes to reducing maternal and infant morbidity and mortality.

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#### References

- Agence Nationale de la Statistique et ICF International (2012). *Enquête démographique et de santé à indicateurs multiples du Sénégal de 2010-11: Rapport de synthèse* Calverton, Maryland, USA: ANSD et ICF International.
- Barnes, J., Bishop, A., & Cuellar, C. (2009). *Senegal private health sector rapid assessment*. Bethesda, MD: Private Sector Partnerships-One project, Abt Associates Inc. ([http://www.shopsproject.org/sites/default/files/resources/5272\\_file\\_FINAL\\_Senegal\\_Assessment\\_rev.pdf](http://www.shopsproject.org/sites/default/files/resources/5272_file_FINAL_Senegal_Assessment_rev.pdf)). [Accessed 23.07.15].
- Bocoum, F. J., Kouanda, S., & Zarowsky, C. (2014). Barriers to antenatal syphilis screening in Burkina Faso. *Pan Afr Med J*. <http://dx.doi.org/10.11694/pamj.suppl.2014.17.1.3423>.
- Carrolli, G., Rooney, C., & Villar, J. (2001). How effective is antenatal care in preventing maternal mortality and serious morbidity? An overview of the evidence. *Paediatric and Perinatal Epidemiology*, 14(Suppl 1), 1–42.
- Di Mario, S. et al. (2005). *What is the effectiveness of antenatal care?* (supplement) Copenhagen: WHO Regional Office for Europe. ([http://www.euro.who.int/\\_data/assets/pdf\\_file/0005/74660/E87997.pdf](http://www.euro.who.int/_data/assets/pdf_file/0005/74660/E87997.pdf)). Accessed 23.07.15
- Fairhead, J., Leach, M., & Small, M. (2006). Where techno-science meets poverty: Medical research and the economy of blood in The Gambia, West Africa. *Social Science and Medicine*. <http://dx.doi.org/10.1016/j.socscimed.2006.02.018>.
- Finlayson, K., & Downe, S. (2013). Why do women not use antenatal services in low- and middle-income countries? A meta-synthesis of qualitative studies. *PLoS Medicine*. <http://dx.doi.org/10.1371/journal.pmed.1001373>.
- Foley, E. (2001). No money, no care: Women and health sector reform in rural Senegal. *Urban Anthropology and Studies of Cultural Systems and World Economic Development*, 30(1), 1–50. <http://dx.doi.org/10.1080/01459740701619830>.
- Foley, E. (2010). *Your pocket is what cures you: The politics of health in senegal* (1st ed.) New Brunswick: Rutgers University Press.
- Forsyth, F. (2015). *Disjunctures in saying and doing: (re)negotiations of intra-household economics in Dakar, Senegal*. M.Sc. thesis. Amsterdam: Graduate School of Social Sciences (GSSS), University of Amsterdam. 2013. (<http://dare.uva.nl/en/scriptie/451497>). [Accessed 20.07.15].
- Francel, A., & Lalou, R. (2009). Health seeking behavior for childhood malaria: Household dynamics in rural Senegal. *J Biosoc Sci*. <http://dx.doi.org/10.1017/S0021932008002885>.
- Geissler, P. W. (2005). 'Kachinja are coming!' Encounters around medical research work in a Kenyan village. *Africa*, 75(2), 173–202.
- Geissler, P. W., & Pool, R. (2006). Popular concerns about medical research projects in sub-Saharan Africa – A critical voice in debates about medical research ethics. *Tropical Medicine and International Health*. <http://dx.doi.org/10.1111/j.1365-3156.2006.01682.x>.
- Gloyd, S., Chai, S., & Mercer, M. A. (2001). Antenatal syphilis in sub-Saharan Africa: Missed opportunities for mortality reduction. *Health Policy and Planning*, 16(1), 29–34.
- Guerin, I. (2008). Poor women and their money: Between daily survival, private life, family obligations and social norms. RUME Working Papers Series, 2. Marseille: IRD.
- Harlow, M.F. (2007). *A qualitative study of pregnancy and maternal mortality in rural Senegal; An examination of the pregnant woman's experience*. MA thesis. Dakar: Amherst College. ([http://digitalcollections.sit.edu/cgi/viewcontent.cgi?Article=1126&context=isp\\_collection](http://digitalcollections.sit.edu/cgi/viewcontent.cgi?Article=1126&context=isp_collection)). [Accessed 23.07.15].
- Kwapong, G. D., Boateng, D., Agyei-Baffour, P., & Addy, E. A. (2014). Health service barriers to HIV testing and counseling among pregnant women attending Antenatal Clinic; A cross-sectional study. *BMC Health Services Research*, 14, 267. <http://dx.doi.org/10.1186/1472-6963-14-267>.
- Larsson, E. C., Thorson, A. E., Pariyo, G., Waiswa, P., Kadobera, D., Marrone, G. et al. (2012). Missed opportunities: Barriers to HIV testing during pregnancy from a population based cohort study in rural Uganda. *PLoS ONE*. <http://dx.doi.org/10.1371/journal.pone.0037590>.
- Ministère de la Santé de l'Hygiène Publique et de la Prévention (2014). *Protocoles de services de SR au Sénégal*. Dakar: Ministère de la Santé de l'Hygiène Publique et de la Prévention. (<http://advancefamilyplanning.org/sites/default/files/resources/Protocoles%20SR.pdf>). [Accessed 23.07.15].
- Ndiaye, P. A., Tal, D. A., Diédou, A., Dieye, E. H. L., & Dione, D. A. (2005). Déterminants socioculturels du retard de la 1re consultation prénatale dans un district sanitaire au Sénégal. *Santé Publique*, 17(4), 531–538([http://www.cairn.info/zen.php?ID\\_](http://www.cairn.info/zen.php?ID_)



- ARTICLE=SPUB\_054\_0531) [Accessed 23.07.15].
- Okeke, I. N. (2011). *Divining without seeds. The case for strengthening laboratory medicine in Africa* (1st ed.) Ithaca and London: Cornell University Press.
- Partnership for Maternal, Newborn and Child Health (2006). *Opportunities for Africa's newborns: Practical data, policy and programmatic support for newborn care in Africa* Geneva: WHO (<http://www.who.int/pmnch/media/publications/oanfullreport.pdf>) [Accessed 23.07.15].
- Pell, C., Meñaca, A., Were, F., Afrah, N. A., Chatio, S., Manda-Taylor, L. et al. (2013). Factors affecting antenatal care attendance: Results from qualitative studies in Ghana, Kenya and Malawi. *PLoS ONE*. <http://dx.doi.org/10.1371/journal.pone.0053747>.
- Petti, C. A., Polage, C. R., Quinn, T. C., Ronald, A. R., & Sande, M. A. (2006). Laboratory medicine in Africa: A barrier to effective health care. *Clinical Infectious Diseases*, 42, 377–382.
- Stadler, J., & Saethre, E. (2010). Rumours about blood and reimbursements in a microbicide gel trial. *African Journal of AIDS Research*. <http://dx.doi.org/10.2989/16085906.2010.545636>.
- Tine, J. Faye, S. Nakhimovsky, S. & Hatt, L. (2014). *Universal health coverage measurement in a lower-middle-income context: A Senegalese case study*. Bethesda, MD: Health Finance & Governance Project, Abt Associates Inc. (<https://www.hfgproject.org/universal-health-coverage-measurement-lower-middle-income-context-senegalese-case-study/>). [Accessed 21.09.16].
- Witter, S., Armar-Klemesu, M., & Dieng, T. (2008). National fee exemption schemes for deliveries: Comparing the recent experiences of Ghana and Senegal. , in: Richard, F., Witter, S., & De Brouwere, V. (Eds.). (2008). *Financing obstetric care*. Antwerp: ITM, 167–198.
- World Health Organization (2010). *Monitoring the building blocks of health systems: A handbook of indicators and their measurement strategies* Geneva: WHO Document Production Services.
- World Health Organization (2015). *Maternal and perinatal country profile Senegal*. ([http://www.who.int/maternal\\_child\\_adolescent/epidemiology/profiles/maternal/sen.pdf](http://www.who.int/maternal_child_adolescent/epidemiology/profiles/maternal/sen.pdf)). [Accessed 16.09.16].