Report 2: Mortality of women and children, coverage of essential maternal and child health services and out-of-pocket payments in rural Guinea-Bissau during PIMI III

Technical appendix to the policy brief 'Mortality of women and children, coverage of essential maternal and child health services and out-of-pocket payments in rural Guinea-Bissau during PIMI III': Report delivered to the Delegation of the European Union to Guinea-Bissau, 31-07-2024

Project:

Coverage, gaps and gains under the PIMI programme: Assessing the real-life implementation and health effects of maternal and child health care in Guinea-Bissau

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ABBREVIATIONS AND ACRONYMS

95%CI	95% confidence interval
ANC	Antenatal care
ANC1	Any antenatal care consultation obtained
ANC4	Four or more antenatal care consultations obtained
ANC8	Eight or more antenatal care consultations obtained
BHP	Bandim Health Project
GEE	Generalised estimating equation
HDSS	Health and demographic surveillance system
IMVF	Instituto Marquês Valle Flôr
IQR	Interquartile range
MCH	Maternal and child health
MINSAP	Ministry of Health of Guinea-Bissau
OOP	Out-of-pocket payment
OR	Odds ratio
PIMI	Integrated Programme for the Reduction of Maternal and Child Mortality
PNC	Postnatal care within 24 hours after birth obtained
XOF	West African CFA franc

1.   BACKGROUND

Despite remarkable progress over the past decades, Guinea-Bissau continues to rank amongst the countries with the highest maternal and child mortality in the world. According to the most recent estimates, Guinea-Bissau has the world's highest stillbirth rate alongside the 5th highest maternal mortality and the 8th highest neonatal mortality (stillbirths: 31/1,000 births; maternal mortality: 725/100,000 live births; neonatal mortality: 34/1,000 live births) (1). Hence, Guinea-Bissau is far from the 2030 goals of reducing stillbirths to below 12 deaths per 1,000 births (2), maternal mortality to below 70 deaths per 100,000 live births, and neonatal mortality to below 12 deaths per 1,000 live births (3).

To improve maternal and perinatal survival, universal access to quality essential maternal and child health (MCH) services is considered essential (4-7). In Guinea-Bissau, the 'Integrated Programme for the Reduction of Maternal and Child Mortality' (PIMI) aims at increasing access to quality MCH services and thereby improve maternal and child survival (8-10). PIMI has been implemented with core funding provided by the European Union (11). The initiative was first introduced in four of the country's eleven health regions in 2013 (PIMI I) before being rolled-out nation-wide in 2017 (PIMI II) (8, 9). In July 2021, after the end of PIMI II, the World Bank integrated PIMI's core activities into the World Bank's country health programme (transition period) (12). In June 2022, PIMI was transitioned back to European Union financing (PIMI III). PIMI III is implemented by Instituto Marquês Valle Flôr (IMVF) and the World Health Organisation's country office Guinea-Bissau in collaboration with the Bissau-Guinean Ministry of Health (MINSAP). To evaluate effects of PIMI III in rural Guinea-Bissau, the Delegation of the European Union to Guinea-Bissau has commissioned the Bandim Health Project (BHP), which was also commissioned to evaluate PIMI's effects in rural Guinea-Bissau during PIMI II. During PIMI III, PIMI's core activities are to be transferred to MINSAP (13).

PIMI employs a comprehensive intervention design including a user-fee waiver policy covering essential MCH services and medicines, capacity building for medical and managerial staff, strengthening of the supply chain of essential medicines and consumables and strengthening of the health information system (10). During PIMI III, reproductive health services are considered a key component of PIMI's core activities. Meanwhile, PIMI does not support the vaccination programme, which is supported by other partners, including UNICEF and GAVI.

In the evaluation of PIMI, BHP builds on its nationally representative rural health and demographic surveillance system (HDSS). This HDSS monitors pregnancies, births, the uptake of health interventions,

and deaths in an open cohort of more than 50,000 women and children under five years of age in rural Guinea-Bissau (14). Thereby, the HDSS provides population-based information on service coverage and mortality from a nationally representative cohort of the full target population of PIMI in rural Guinea-Bissau independent of health-facility data.

Based on data from the BHP's rural HDSS, our prior reports document that while coverage of essential MCH services increased impressively during the implementation of PIMI I and II (15, 16), coverage remained suboptimal and perinatal mortality stagnated on an alarming level of approximately 80 deaths per 1,000 births (16). We have also documented ubiquitous persisting barriers to quality MCH services despite PIMI's implementation, including pronounced financial and geographical barriers to care alongside substantial material and human-resource constraints at the health facilities (17). Causing severe delays to care and compromising health-facility responsiveness and quality of care, this may explain why perinatal mortality remained high despite coverage increases during PIMI I and II (17). In our most recent report from February/March 2023, we documented that upon the implementation of PIMI III, coverage of essential MCH services continued to remain suboptimal with only small improvements in comparison with the prior years. Meanwhile, mortality of women of reproductive age and children remained largely stable on a very high level (18).

In this report, using BHP's rural HDSS data, we describe mortality of women of reproductive age and children under 5 years of age and perinatal mortality during PIMI III in rural Guinea-Bissau, along with the coverage of essential MCH services and equity in coverage. Furthermore, we describe the prevalence and level of out-of-pocket payments (OOPs) for essential MCH services during PIMI III in rural Guinea-Bissau. We also provide an assessment of health facility characteristics and potential associations with service coverage.

2. OBJECTIVES

We assessed the mortality of women of reproductive age and children under 5 years of age and perinatal mortality in 2023. Further, we assessed coverage of essential MCH services (antenatal care (ANC), facility births, postpartum admission, postnatal care (PNC), childhood vaccinations) and equity in coverage in 2023 along with OOPs for essential MCH services (ANC and facility births) for which we surveyed a sample of HDSS-registered women between August 2023 and March 2024. Moreover, we surveyed a sample of health facilities between January and April 2023 to describe their characteristics and to assess potential associations with service coverage in their target areas.

3. METHODS

3.1. Study design and data collection

We employed an observational study design based on data from BHP's rural HDSS which has, in its current set-up, been running since 2006. Through this HDSS, we are continuously monitoring >50,000 women of reproductive age and children below 5 years of age in a nationally representative random sample of 182 village clusters across all ten rural health regions in Guinea-Bissau (i.e., all health regions with the exception of the capital region) (Figure 1) (14).

BHP's rural HDSS is an open cohort. Upon informed consent, women who have grown up in an HDSS village cluster and reached fertile age are enrolled as a cohort member. The same applies to women and children below 5 years of age who have moved into an HDSS village cluster. At each visit, registered women are asked if they are pregnant; if they are, the yet unborn child is registered. Children exit the cohort upon reaching 5 years of age, death, or out-migration; women upon death or out-migration.

HDSS cohort members are followed through at least biannual household visits (more frequent visits in selected health regions). Upon registration of a woman, information on ethnicity, age, schooling, and obstetric history is collected. At all household visits, women are asked whether they are pregnant and/or had a birth or miscarriage since the last visit. Upon pregnancy registration and follow up, information on obtained ANC is collected. Information on socio-economic background factors is collected upon registration of a pregnancy or in-migrating children. Upon registration of pregnancy outcomes and in-migrating infants, (further) information on ANC and the place of birth is collected. Data on childhood vaccinations is collected and updated during every household visit (14). Since 2012, we have also been collecting information on the health facility the birth took place in. Since January 2023, we have additionally been inquiring whether and how long the woman remained at the health facility after a facility birth (postpartum admission), and whether the woman and the newborn have obtained a PNC check-up, including its timing (regardless of place of birth).

In addition to the here described rural HDSS, since 2015, the BHP implements a parallel system using the same methodology in the region Bafatá, thereby expanding the surveillance by 40 village clusters with approximately 4,500 women of reproductive age and 4,000 children (Figure 1).

Figure 1: Village clusters under surveillance by the Bandim Health Project across rural Guinea-Bissau (the nationally representative sample of 182 village clusters is illustrated with dots; the 40 additional village clusters in Bafatá with circles).

To assess mortality and coverage, we assessed the following outcomes based on data from the rural HDSS:

i) Mortality of women of reproductive age;
ii) mortality of children under 5 years of age;
iii) perinatal mortality;
iv) proportion of women who have obtained one or more ANC consultation (ANC1);
v) proportion of women who have obtained four or more ANC consultations (ANC4);
vi) proportion of women who have obtained eight or more ANC consultations (ANC8);
vii) proportion of women who have given birth at a health facility;
viii) proportion of women who have given birth at a health facility and remained at the health facility for at least 24 hours after birth (postpartum admission);
ix) proportion of women who had a PNC contact within 24 hours after birth;
x) childhood vaccination coverage.

To assess equity in coverage, we assessed associations between the background factors detailed in Table 1 (household assets, maternal education, parity, maternal age, region, ethnicity, distance to the nearest health facility) and coverage.

Table 1: Background factors

Background factor	Source of information	Classification
Household assets Index counting +1 for each of a total of five possible items: (i) living in a house with a hard roof; (ii) access to a toilet; (iii) possession of a mobile phone, (iv) radio, and (v) generator	Pregnancy registration; registration of in-migrating children.	Categorical: 0-2 items, 3-4 items, 5 items
Maternal education[1] Level of maternal education	First registration of the woman.	Categorical: No schooling, primary school (1-4 years schooling completed), secondary school or higher (5+ years completed)
Parity Numbers of registered births prior to the index birth	First registration of the woman and update through routine follow-up.	Categorical: None, 1, 2-3, 4+
Maternal age Maternal age at the date of birth of the index birth in years	First registration of the woman; birth outcome registration.	Categorical: <20, 20-24, 25-29, 30-34, 35+
Region Region of residency	Registered at the first registration of a pregnancy or child.	Categorical: Oio, Biombo, Gabu, Cacheu, Bafatá, Quinara, Tombali, Bolama/Bubaque, Farim
Ethnicity Maternal ethnicity	Registered at first registration of the woman.	Categorical: Balanta, Fula/Mandinga, Manjaco/Mancanha, Pepel, Beafada, Bijagós, other
Distance[2] Distance to nearest health facility in kilometre	Calculated straight-line distance between village and health facility from GPS coordinates.	Categorical: <2, 2-5, 5-8, 8+

[1] Women for whom it was known that they had attended school, but the highest completed grade was unknown were classified as having attended primary school. [2] Distance is assessed as straight-line distance based on GPS coordinates of the HDSS villages and positioning of the health facilities obtained from UNICEF data (19).

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To assess mortality and the coverage of essential MCH services including equity in coverage, we defined the calendar year 2023 as the observation period. For the assessment of perinatal mortality and service coverage, the observation period corresponds to births occurring during this time frame. For mortality of women of reproductive age and children below the age of 5 years, the observation period corresponds to time of observation. The methodology applied in the mortality and coverage assessments is described in the following sections 3.2 and 3.3, respectively.

Moreover, nested in the HDSS, we implemented a cross-sectional study to investigate the prevalence and level of OOPs for essential MCH services in rural Guinea-Bissau. For this purpose, we inquired OOPs for ANCs and births among HDSS-registered women between August 2023 and March 2024 during our routine HDSS visit. For OOPs related to ANCs, we interviewed pregnant women on their most recent ANC consultation before the HDSS visit; for OOPs related to births, we interviewed women who had given birth since the last HDSS visit on this birth. In addition to BHP's regular rural HDSS cohort, we extended the inclusions to the parallel system run by the BHP in Bafatá. Information collected included OOPs by cost category (service provision, materials, diagnostics, medicine, and transportation), as well as the number of ANC consultation interviewed about and the location and nature of the potential peripartum care contact (facility birth vs. homebirth with/without a health-system contact to seek PNC as soon as possible after birth). The methodology applied in the analyses of OOPs is described in section 3.4.

To assess health facility characteristics and potential associations with service coverage, we furthermore collected data in 35 health facilities in Biombo, Oio and Bafatá between January and April 2023. We linked data from the health facility survey to HDSS data from these health areas to correlate health facility characteristics with the coverage in the target area. The methodology applied in the analyses of health facility characteristics is described in section 3.5.

3.2. Mortality of women of reproductive age and children

For the mortality assessments, we firstly report on mortality rates among women of reproductive age. To take into account that women can enter and/or leave the cohort due to in-and out-migration and age, we relate the number of registered deaths in women aged 15-49 years to the number of person years under observation. We present the mortality rates for women aged 15-49 years with a 95% confidence interval (95%CI) adjusted for cluster. We present the estimates stratified by 5-year age intervals. For 226 of 27,560 followed women, we had not obtained information on age at registration.

For these women, we assigned an age at registration based on the median age among women of same parity.

Similarly, for under-5 mortality, we calculated the mortality rate as the number of under-5 deaths per 1,000 person years of observation also considering that children can enter and exit the cohort. To further take into account that the proportion of children registered before birth and thus contributing to the mortality assessment differs across regions due to more frequent visits in some regions, we present the rates for the neonatal period (<28 days of age), post-neonatal infancy (1-11 months) and post infancy (12-59 months) with a 95%CI adjusted for cluster. Using Kaplan-Meier estimates, we furthermore estimated the under-5, infant and neonatal mortality as the number of deaths per 1,000 live births, assuming that children under study at a particular age interval were representative of the whole population.

For perinatal mortality, we assessed stillbirths and early neonatal deaths during the first week of life among all births registered prior to birth. This is because we do not expect that we can obtain full, unbiased information on retrospectively registered birth outcomes (14, 20). Using descriptive statistics, we assessed the distribution of background factors in the full analytical sample. Using binomial regression models with generalised estimating equation (GEE) correction for possible cluster effects, we also assessed background factors associated with perinatal death. Considered background factors are detailed in Table 1 and comprised household assets (living in a house with a hard roof, access to a toilet, possession of a mobile phone, radio, and generator), maternal education, parity, maternal age, region, distance to health facility and ethnicity.

Observations with missing information were omitted from the relevant analyses. All analyses were conducted in Stata 18.0.

3.3. Coverage of essential maternal and child health services and equity in coverage

In the coverage assessments, we assessed the proportions of women who obtained ANC1, ANC4, ANC8, facility births, postpartum admission and PNC, and vaccination coverage in children in the rural HDSS areas for births between 1 January 2023 and 31 December 2023. Table 2 provides an overview of the assessed coverage indicators including their definition and source of information.

Table 2: Outcome indicators (coverage analyses).

Outcome indicator	Source of information
Antenatal care • Proportion of women who have obtained any antenatal care consultation (ANC1) for the index birth. • Proportion of women who have obtained four or more antenatal care consultations (ANC4) for the index birth. • Proportion of women who have obtained eight or more antenatal care consultations (ANC8) for the index birth.	Pregnancy outcome registration and registration of in-migrating infants. Based on oral information from household interviews and information from antenatal care cards (counted if either source of information indicated the attainment of ANC1/ANC4/ANC8).
Facility births • Proportion of women who have given birth at a health facility (index birth).	Pregnancy outcome registration and registration of in-migrating infants. Based on oral information from household interviews.
Postnatal care • Proportion of women who have given birth at a health facility and remained at the health facility for at least 24 hours after birth (postpartum admission). • Proportion of women who had a postnatal care contact within 24 hours after birth (PNC).	Pregnancy outcome registration and registration of in-migrating infants. Based on oral information from household interviews.
Childhood vaccinations Proportion of children who have obtained the following vaccines by 12 months of age: • Bacillus Calmette-Guérin vaccine scheduled at birth (BCG) • Oral polio vaccine scheduled at birth (OPV Birth) • Oral polio vaccine scheduled at 6, 10 and 14 weeks of age (OPV 1-3) • Pentavalent vaccine against diphtheria, pertussis, tetanus, hepatitis B and Haemophilus influenza type B scheduled at 6, 10 and 14 weeks of age (Penta 1-3), • Measles vaccine scheduled at 9 months of age (MV1)	Routine follow-up of childhood vaccinations. Based on information from vaccination cards. Coverage by 12 months of age was assessed among children with card inspected between 12 and 23 months of age.

In the assessments of ANC, facility birth, postpartum admission, and PNC coverage, we restricted the analytical sample to births registered within 12 months after birth. This is because the relevant information is collected upon the registration of the birth outcome, and the information is only collected for in-migrating children below one year of age. Further exclusion criteria were miscarriage, out-migration from the rural HDSS area before the birth, and death of the mother during pregnancy. In the vaccination coverage assessments, we restricted the analyses to children with card inspected between 12 and 23 months of age. No restrictions based on the timing of the child's registration in the HDSS were applied.

Using descriptive statistics, we assessed the coverage of each outcome for the full analytical sample. Further, using descriptive statistics, we assessed the distribution of background factors in the full analytical sample. Moreover, to assess equity in coverage, we compared coverage by background factors using binomial regression models with GEE correction for possible cluster effects. Considered background factors are detailed in Table 1. For the childhood vaccinations, we also described vaccination timeliness using Kaplan-Meier curves.

In sensitivity analyses, we limited the assessment of ANC coverage to observations where information on the number of ANC consultations was obtained from an ANC card. Further, we limited the analyses of all assessed coverage outcomes to observations where the woman was present to provide information (i.e., exclusion of proxy reporting) and where the pregnancy was registered prior to birth.

Observations with missing information were omitted from the relevant analyses. All analyses were conducted using Stata 18.0.

3.4.   Out-of-pocket payments

Using descriptive statistics, we assessed the prevalence and level of OOPs in relation to ANCs and births. For ANCs, we described the prevalence and level overall and stratified by the number of ANC consultation interviewed about among women who had sought ANC; for births, we described the prevalence and level overall and stratified by the birthing location and nature of a potential peripartum care contact (facility birth vs. homebirth with/without a health-system contact to seek PNC as soon as possible after birth). In the assessments of OOP prevalences, we described the proportions of women reporting OOPs regardless of whether they remembered the value paid. In the assessments of OOP levels, all reported costs relate to values reported by women who indicated to remember the total value paid. In the assessments of OOP levels, we described absolute amounts paid overall and by

stratum, as well as by the proportion of the overall OOP for each cost category. In the assessment of OOP levels by cost categories, all reported costs relate to values reported by women who could recall all payments by cost categories (i.e., for OOPs at the point of care: services, materials, diagnostics, medicine and other expenses; for any OOPs, beforementioned categories and transportation).

Moreover, we linked the OOP survey data to routine HDSS data to assess background factors associated with the prevalence of OOPs. In addition to the background factors described above (cf. Table 1), for ANC, we considered

- the number of consultation interviewed about;
- the type of health facility sought (i.e., public health centre, regional hospital, private/faith-based health centre); and
- whether care was provided during community outreach or sought outside of the Bissau-Guinean health system.

For births, we considered the following background factors for all births in addition to the background factors described above (cf. Table 1):

- ANC obtained during the pregnancy of the birth interviewed about: ANC1, ANC4, ANC8;
- Birth characteristics: Birth outcome (livebirth, stillbirth, early neonatal death) and whether the pregnancy was a twin pregnancy.

In addition, for facility births, we considered the type of health facility (i.e., public health centre, regional hospital, national hospital, private/faith-based health centre) and whether care was sought outside of the Bissau-Guinean health system (especially relevant for villages close to the border to Senegal). Furthermore, we considered the type of birth (i.e., vaginal without use of instruments, assisted with instruments, c-section), and whether uterotonics were provided. Using descriptive statistics, we assessed the prevalence of OOPs by background factors for both ANCs and facility births.

In sensitivity analyses, we restricted the assessments of OOP levels for ANC and facility births to care obtained through public health centres and regional hospitals in Guinea-Bissau (including ANC obtained through community outreach), thereby excluding care obtained at the National Hospital Simão Mendes, private/faith-based health centres and at health facilities abroad.

All payments are reported in West African CFA franc (XOF). We also converted the payments into Euro (EUR) using the official exchange rate published by the European Commission at 1 XOF = 0.00152 EUR (21).

3.5. Health facility characteristics

Information on health facility characteristics was collected through structured interviews and questionnaires at 35 health centres between January and April 2023. We interviewed the most senior person responsible of each health centre about the health facility characteristics (Table 3).

Table 3: Information on health facilities collected during 2023.

Area	Theme	Sub-questions
Organisation	What are the opening hours at this health facilities?	Normal opening hours / open only for emergencies / closed
Service provision	Which days are ANC consultations provided at this health facility?	When do they normally start /end?
	How long where the waiting times during the past week for the services listed in the sub-questions?	Mean waiting time for: - ANCs - Births
Service fees / incentives	What does it cost for a woman with a prior birth at this health facility / primigravida to receive the services listed in the sub-questions? What does it cost for a woman with a prior birth at another health facility to receive the services listed in the sub-questions?	- ANC consultation - ANC card - Tetanus vaccination card - Childhood vaccination - Childhood vaccination card - Birth assistance
	Did you during the past month provide materials listed in the sub-questions to women/children (free of charge)?	Bed net for children / bed net for pregnant women / medicine / birthing kit / other (specify:_____)
Supplies	During the past 7 days did you experience a stock out of the materials necessary to provide health services listed in the sub-questions?	Medicine/vaccines which are normally provided at no charge. Medicine/vaccines which are normally provided at a cost to the patient. Yes / no / which
	During the past 7 days, did you experience a stock out of instruments necessary to provide health services?	Yes / which / no
Referral systems	Do you have a vehicle for patient transport?	Yes / number / no
	How much is the transport to the next higher-level facility?	Value, yes / no

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	Does the health staff manage the transport of the patient?	
Laboratory facilities	Do you perform examinations / analyses at this health facility?	Yes, free / yes, at a cost / no
Self-evaluation of health facility infrastructure	How do you assess the infrastructure of your health facility?	Scale (very good – very bad)
Birthing facilities	Does the health facility have a birthing room? Is it providing privacy from male patients?	Yes / no
Training	Has your health facility staff received training during the past month (on-/off-site)?	If yes, theme

To assess whether health facility characteristics were associated with service coverage, we used HDSS data for births between January 2021 and December 2022 from the health areas of the included health facilities, and fitted multilevel models for the outcomes facility birth and ANC4. For each of the outcomes, we fitted four models: An empty model, accounting for the hierarchical structure pregnancies/births in family groups, villages, health areas. A model 2 adding the health facility and village-level predictors (information from the survey (cf. Table 3) and distance to health facility) to the empty model. A model 3 adding to the empty model the individual-level child- and maternal predictors (obtained through the HDSS (cf. Table 1)). And finally, a model 4 including both variables from model 1 and model 3. As potential predictors, we included factors that were associated with coverage in a univariate model (statistically significant at an 80% level).

3.6.   Ethics

BHP's rural HDSS is implemented at the request of MINSAP, and the data collection has been approved by the Bissau-Guinean Ethics Committee. Informed consent has been sought for participant registration. For the implementation of the OOP questionnaires and the health facility survey, we also obtained ethical approval from the Bissau-Guinean Ethics Committee (Ref. 004/CNES/INASA/2023 and 030/CNES/INASA/2023).

4. RESULTS

4.1. Mortality of women of reproductive age and children

Between 1 January and 31 December 2023, we followed 27,560 women aged 15-49 years. In total, these women under surveillance contributed with 24,910 person years and 114 women died, yielding a mortality rate of 4.58 (95%CI 3.85-5.48) (Table 4). Mortality of women of reproductive age increased across age groups (Table 4). Follow-up was complete (i.e., data until 31 December 2023 fully available) for 25,772 (94%) of the women while information for the last months of 2023 is missing for the remaining 1,788 women (6%) at the time of reporting.

Table 4: Mortality of women aged 15-49 years between January and December 2023.

	Deaths / Observation time (Person years)	Mortality rates per 1000 person years (95%CI)
All	114 / 24,910	4.58 (3.85-5.48)
Age group		
15-19 years	6 / 4,451	1.35 (0.63-3.45)
20-24 years	14 / 4,861	2.88 (1.65-5.50)
25-29 years	21 / 4,373	4.80 (3.19-7.57)
30-34 years	20 / 3,751	5.33 (3.50-8.53)
35-39 years	16 / 3,138	5.10 (3.24-8.49)
40-44 years	22 / 2,496	8.81 (5.95-13.65)
45-50 years	15 / 1,841	8.15 (5.13-13.78)

During the same period, we followed 19,359 children under 5 years of age, for a total of 15,225 person years. Follow-up was complete for 18,490 (95%) of these children while information from the first visit of 2024 of the remaining 869 children (4%) is not yet available for analysis. During the period under surveillance, 246 died. The estimated under-5 mortality was 78 per 1,000 live births (Figure 2, left panel), while the infant mortality and neonatal mortality rates were estimated at 60 and 34 per 1,000 live births, respectively (Figure 2, right panel). During the neonatal period, the mortality rate was 442.5 per 1,000 person years (95%CI 345.3-578.1), while it was 29.5 per 1,000 person years (95%CI 23.8-37.0) for 1-11-month-old children and 4.9 per 1,000 person years (95%CI 3.8-6.4) for 1-4-year-old children (Supplementary Table 1).
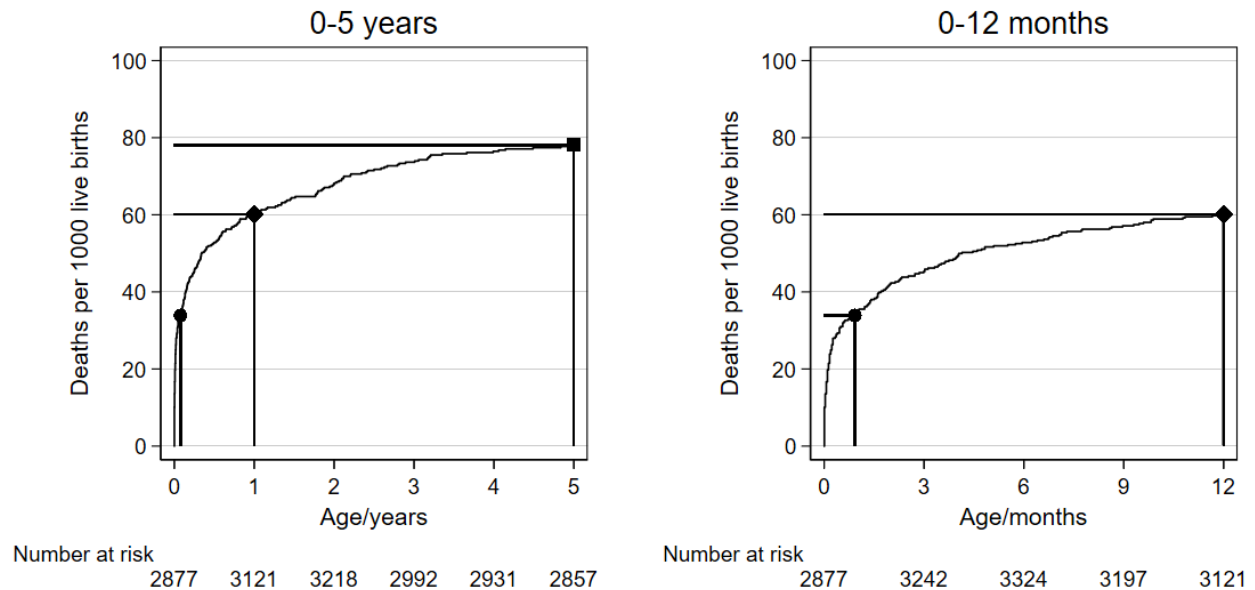
Figure 2: Estimated cumulative mortality between birth and 5 years of age between January and December 2023. Neonatal (dot), infant (diamond) and under-5 (square) mortality indicated on left panel (mortality for the first 5 years of life). Neonatal (dot) and infant (diamond) mortality indicated on right panel (mortality for the first year of life).

For the assessment of perinatal mortality, we included a total of 3,026 births. Supplementary Table 2 displays the distribution of background factors in the analytical sample, with slightly over half of the births being among women from households with all five assessed possessions, more than one in three women having no formal education while the remaining were evenly distributed between only primary schooling, and secondary or higher.

Among the births, the perinatal mortality was 72 per 1,000 births (95%CI 64-82). The binomial regression model revealed higher perinatal mortality rates among women with no formal education, and a U-shaped relation for parity with higher perinatal mortality rates in primigravidae and grand-multiparous women. A similar pattern was also observed for maternal age. There was also substantial variation across regions and ethnicities (Supplementary Table 3).

4.2. Coverage of essential maternal and child health services and equity in coverage

A total of 3,876 births were eligible for the coverage analyses of ANC, facility births, postpartum admission, and PNC (Figure 3).
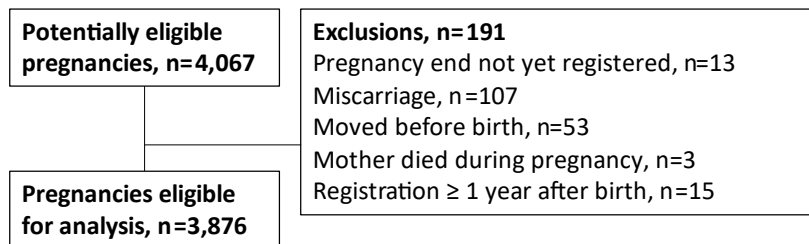
Potentially eligible pregnancies, n=4,067	Exclusions, n=191
	Pregnancy end not yet registered, n=13
	Miscarriage, n=107
	Moved before birth, n=53
Pregnancies eligible for analysis, n=3,876	Mother died during pregnancy, n=3
	Registration ≥ 1 year after birth, n=15

Figure 3: Flowchart for the antenatal care, facility birth, postpartum admission, and postnatal care coverage assessments.

Table 5 describes the maternal background characteristics of the analytical sample. Slightly more than half of the women came from households which possessed all assessed five household items (2,024/3,763, 54%), 6% came from households in the poorest category with zero to two items (236/3,763). The level of maternal schooling was low with 36% having obtained no schooling (1,367/3,780) and 31% having only attended primary school (1,175/3,780). Half of the women had one to three prior births (1 prior birth: 653/3,624, 18%; 2-3 prior births: 1,113/3,624, 31%), and slightly more than half of the women were between 20 and 30 years of age (20-24 years: 1,049/3,821, 27%; 25-29 years: 976/3,821, 26%). Most women lived in Oio (653/3,876, 17%), the fewest in Bolama/Bubaque and Farim (Bolama/Bubaque: 149/3,876, 4%; Farim: 94/3,876, 2%). Fula/Mandinga and Balanta were the biggest ethic groups (Fula/Mandinga: 1,558/3,853, 40%; Balanta: 1,161/3,853, 30%). Over half of the women lived more than five kilometres from the nearest health facility (5-8 km: 1,162/3,876, 30%; >8 km: 933/3,876, 24%) (Table 5).

Table 5: Background characteristics of the analytical sample for antenatal care, facility birth, postpartum admission, and postnatal care coverage

	n (%)	Missings/N (%)
Total	3,876 (100)	0/3,876 (0)
Household assets		113/3,876 (3)
0-2 items	236 (6)	
3-4 items	1,503 (40)	
5 items	2,024 (54)	
Maternal education		96/3,876 (2)
No schooling	1,367 (36)	
Primary school	1,175 (31)	
Secondary or higher	1,238 (33)	
Parity		252/3,876 (7)
Primigravida	802 (22)	
1 prior birth	653 (18)	
2-3 prior births	1,113 (31)	
4+ prior births	1,056 (29)	
Maternal age		55/3,876 (1)
<20	567 (15)	
20-24	1,049 (27)	
25-29	976 (26)	
30-34	736 (19)	
35+	493 (13)	
Region		0/3,876 (0)
Oio	653 (17)	
Biombo	503 (13)	
Gabu	618 (16)	
Cacheu	598 (15)	
Bafatá	484 (12)	
Quinara	392 (10)	
Tombali	385 (10)	
Bolama/Bubaque	149 (4)	
Farim	94 (2)	
Ethnicity		23/3,876 (1)
Balanta	1,161 (30)	
Fula/Mandinga	1,558 (40)	
Manjaco/Mancanha	179 (5)	
Pepel	420 (11)	
Beafada	237 (6)	
Bijagós	89 (2)	
other	209 (5)	

Distance to nearest health facility		0/3,876 (0)
<2 km	1,001 (26)	
2-5 km	780 (20)	
5-8 km	1,162 (30)	
>8 km	933 (24)	

Overall, ANC1 coverage was 99% (3,515/3,549), ANC4 coverage 62% (1,630/2,641), ANC8 coverage 6% (146/2,641), facility birth coverage 58% (2,097/3,599), and PNC coverage 46% (1,232/2,678). Among women who gave birth at a health facility, 81% remained at the hospital for at least 24 hours after birth (postpartum admission) (1,468/1,816) and 80% obtained PNC (1,128/1,412) (Figure 4, Table 6, Table 7). Sensitivity analyses yielded results similar to the main analysis (Table 6, Table 7).
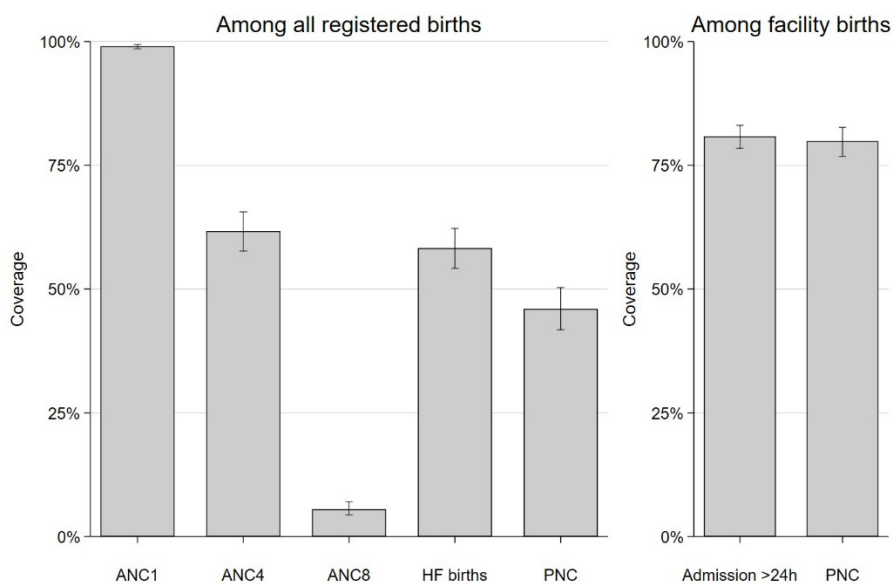

Figure 4: Coverage of at least one/four/eight antenatal care visits (ANC1/ANC4/ANC8), facility births (HF births, and postnatal care (PNC) among all registered pregnancies (left); coverage of postpartum admission and PNC among HF births (right).

Table 6: Sensitivity analyses for coverage analyses of antenatal care (ANC).

	ANC1 % (n/N)	ANC4 % (n/N)	ANC8 % (n/N)
Main analysis	99 (3,515/3,549)	62 (1,630/2,641)	6 (146/2,641)
Sensitivity 1: Restriction to ANC card seen	100 (2,272/2,274)	50 (1,131/2,274)	3 (66/2,274)
Sensitivity 2: Restriction to maternal reporting	99 (2,590/2,618)	63 (1,575/2,497)	6 (143/2,497)
Sensitivity 3: Restriction to pregnancy registration before birth	99 (3,233/3,264)	61 (1,469/2,391)	5 (124/2,391)

Table 7: Sensitivity analyses for coverage analyses of facility births, postpartum admission, and postnatal care (PNC).

	Facility births % (n/N)	Postpartum admission % (n/N)	PNC facility births % (n/N)	PNC all births % (n/N)
Main analysis	58 (2,097/3,599)	81 (1,468/1,816)	80 (1,128/1,412)	46 (1,232/2,678)
Sensitivity 2: Restriction to maternal reporting	56 (1,474/2,613)	78 (1,089/1,394)	81 (986/1,220)	47 (1,074/2,265)
Sensitivity 3: Restriction to pregnancy registration before birth	57 (1,904/3,315)	81 (1,327/1,630)	80 (995/1,250)	45 (1,092/2,432)

We found a pronounced negative association between coverage of ANC, facility births and PNC (assessed among all births) and distance to the nearest health facility: In comparison with women living close to the nearest health facility (<2 km), coverage rates amongst women living further away dropped markedly. We observed the largest drop for facility births. Here, coverage amongst women living <2km from the next health facility was 82% (771/938), but only 58% for those living 2-5 km away (430/746; odds ratio (OR) 0.27 (95%CI 0.18-0.40)), 46% for those living 5-8 km away (476/1,043; OR 0.19 (95%CI 0.14-0.27)), and 48% for those living more than 8 km away (420/872; OR 0.19 (95%CI 0.13-0.27)). This pattern was different for the outcomes assessed among facility births (postpartum admission and PNC among facility births), where distance was no longer associated with coverage. Meanwhile, we found a pronounced regional heterogeneity in the coverage rates, with the highest rates of ANC, facility births and PNC (assessed among all births) observed in Bolama/Bubaque and the lowest in Oio and, for ANC8,

Gabu. This pattern was different for the outcomes assessed among facility births (postpartum admission and PNC among facility births): Here, the highest postpartum admission rates were observed in women from Farim, Oio, and Tombali; the highest PNC rates in Tombali and Gabu. Similarly, there were pronounced heterogeneities between ethnic groups across the outcomes (Supplementary Tables 4-6).

We also observed coverage of ANC4 and PNC to be associated with household wealth: In comparison with the poorest group, women allocated to the intermediate and richest groups were statistically significantly more likely to obtain ANC4 and PNC (ANC4: 3-4 items: OR 1.47 (95%CI (1.04-2.06)); 5 items: OR 1.67 (95%CI 1.14-2.44); PNC facility births: 3-4 items: OR 2.08 (95%CI 1.19-3.61); 5 items: OR 2.38 (95%CI 1.35-4.20); PNC overall: 3-4 items: OR 1.61 (95%CI 1.17-2.23); 5 items: OR 1.97 (95%CI 1.40-2.76). All other outcomes showed the same tendency (not statistically significant), except for postpartum admission, which showed the opposite tendency of higher coverage in women from poorer households. Similarly, higher maternal schooling was associated with higher coverage for most outcomes except for postpartum admission and PNC among facility births, which showed the opposite tendency. Women who had given birth before had considerably lower coverage rates of facility births and PNC (among all births) in comparison with primigravidae, which was statistically significant for all categories. We observed the same for ANC4 in grand multipara (4+ prior births). At the same time, we found a mixed pattern for maternal age: In comparison with teenage women (< 20 years of age), women in the older age groups (≥ 20 years) tended to be more likely to obtain ANC4, ANC8 and, among facility births, PNC, but were statistically significantly less likely to obtain facility births with a similar tendency for PNC among all births (Supplementary Tables 4-6).

For the vaccination coverage assessment, 542 children were eligible for the analysis (Supplementary Figure 1). Overall, 96% of the analytical sample obtained the Bacillus Calmette-Guérin vaccine scheduled at birth (523/542), 54% the oral polio vaccine scheduled at birth (295/542), 92% three doses of the pentavalent vaccine scheduled at 6, 10 and 14 weeks of age (496/542), 68% three doses of the oral polio vaccine scheduled at 6, 10 and 14 weeks of age (367/542), and 75% the measles vaccine scheduled at 9 months of age (409/542) (data not shown). Figure 5 describes the timeliness of the assessed vaccines. There was a steep increase in the coverage of the pentavalent vaccine at the points of its scheduled provisions which for the first dose continued up to around 70% coverage, indicating that the provision of the pentavalent vaccine, at least for the first dose, was largely according to schedule. In contrast, timeliness and coverage of the co-administered oral polio vaccine was lower, especially for the second and third doses. Both the Bacillus Calmette-Guérin vaccine, oral polio vaccine

at birth and measles vaccine had relatively steep increases initially, but for the Bacillus Calmette-Guérin and measles vaccine, the increase was less steep after 50% coverage, and oral polio vaccination at birth and measles vaccination reached considerably lower coverage rates in comparison with the pentavalent vaccinations (Figure 5).
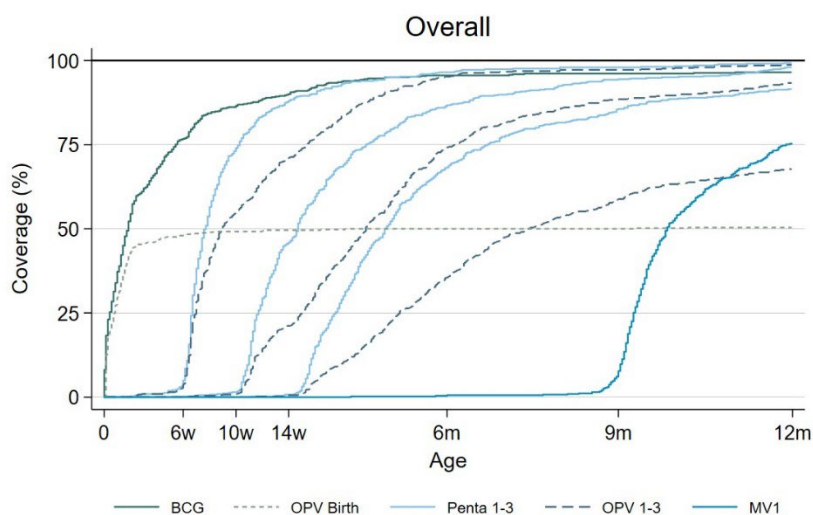

Figure 5: Timeliness of childhood vaccinations (Bacillus Calmette-Guérin vaccine (BCG), oral polio vaccine at birth (OPV birth), pentavalent vaccine against diphtheria, pertussis, tetanus, hepatitis B and Hib at 6, 10 and 14 weeks of age (Penta 1-3), oral polio vaccine at 6, 10 and 14 weeks of age (OPV 1-3), and measles vaccine (MV)), full analytical sample.

4.3.   Out-of-pocket payments

For the assessment of OOPs for ANCs, we interviewed 1,590 HDSS-registered women who reported being pregnant during the HDSS visit. A total of 1,197 of these women reported having initiated ANC. Among them, 36% were interviewed on their first ANC consultation (416/1,197), 28% on their second (320/1,197), 18% on their third (210/1,197), and 17% on their fourth or higher (197/1,197), while 5% of the women could not recall the number of their last ANC (54/1,197) (Supplementary Table 7). Supplementary Table 7 displays the background characteristics of the analytical sample.

Overall, 81% of the women who had sought ANC reported OOPs at the point of care (henceforth: point-of-care OOPs) at their most recent ANC consultation (966/1,197). Taking payments for transportation into account, 90% of the women who had sought ANC reported any OOPs (1,073/1,197). The proportion of women reporting OOPs was highest for the first ANC consultation and declined with increasing numbers of ANC consultations (Figure 6, Supplementary Table 8, Supplementary Table 9).

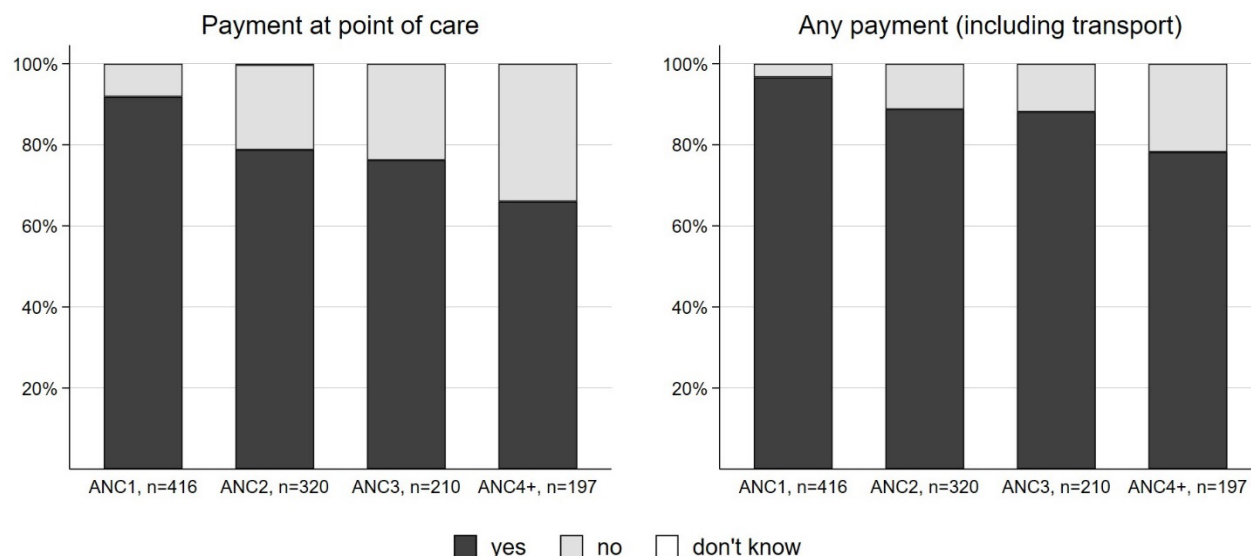## Prevalence of out-of-pocket payments for ANCs

Figure 6: Prevalence of out-of-pocket payments for antenatal care (ANC), by number of ANC consultation.

Across the assessed background factors, the prevalence of OOPs was markedly lower among woman from households allocated to the poorest group (point-of-care OOPs: 68% (28/41), any OOPs: 78% (32/41)), and the prevalence tended to be lower among women with higher education. There were also substantial regional variations. Further, OOPs tended to be more prevalent when the nearest health facility was not in close proximity to the residency, and when care was sought at private or faith-based health facilities or at health facilities abroad. In contrast, the prevalence of OOPs was substantially lower for ANC provided during community outreach (Supplementary Table 8, Supplementary Table 9).

Across ANCs, point-of-care OOPs amounted to a median of 2,000 XOF (interquartile range (IQR) 1,000-4,500 XOF) (3€ (IQR 2-7€)); OOPs including transportation costs (henceforth: total OOPs) to a median of 3,000 XOF (IQR 1,000-5,500 XOF) (5€ (IQR 2-8€)). Point-of-care OOPs were highest for the first ANC consultation at a median of 4,000 XOF (IQR 1,500-6,000 XOF) (6€ (IQR 2-9€)) and remained similar when including transportation costs (4,000 XOF (IQR 2,000-7,000 XOF) (6€ (IQR 3-11€))) (Figure 7). OOP levels declined with increasing numbers of ANC consultations both for point-of-care and total OOPs (Figure 7).

Restricting the assessment to antenatal care obtained at public health centres, regional hospitals and during community outreach (exclusion of care sought at private/faith-based health centres and health facilities aboard) yielded similar point-of-care OOPs at a median of 2,000 XOF (IQR 1,000-4,000 XOF)

(3€ (IQR 2-6€)) and total OOPs at 3,000 XOF (IQR 1,000-5,000 XOF) (5€ (IQR 2-8€)) across ANCs (data not shown).
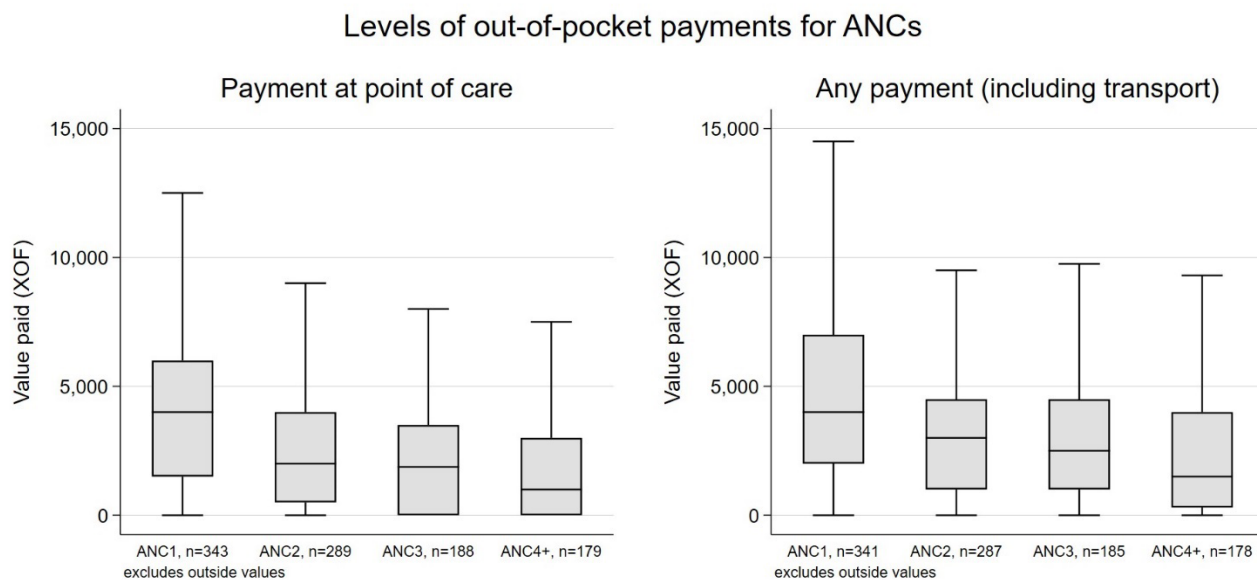

Figure 7: Level of out-of-pocket payments for antenatal care (ANC) (median with inter-quartile range (box) and range), by number of ANC consultation.

Across ANCs, payments for medicine accounted for the highest proportion of the total OOPs (on average 47%), followed by diagnostics (18%), transportation (17%), and service provision (9%) (Figure 8). In addition, payments for ANC cards (i.e., the pregnancy and tetanus vaccination card) accounted for 24% of point-of-care OOPs for the first ANC consultation (Figure 8). Accordingly, among all women who had sought ANCs and recalled the value paid for the cards (n=1,137), the median payment for ANC cards amounted to 1,000 XOF (IQR 0-1,000 XOF) (2€ (IQR 0-2€)).

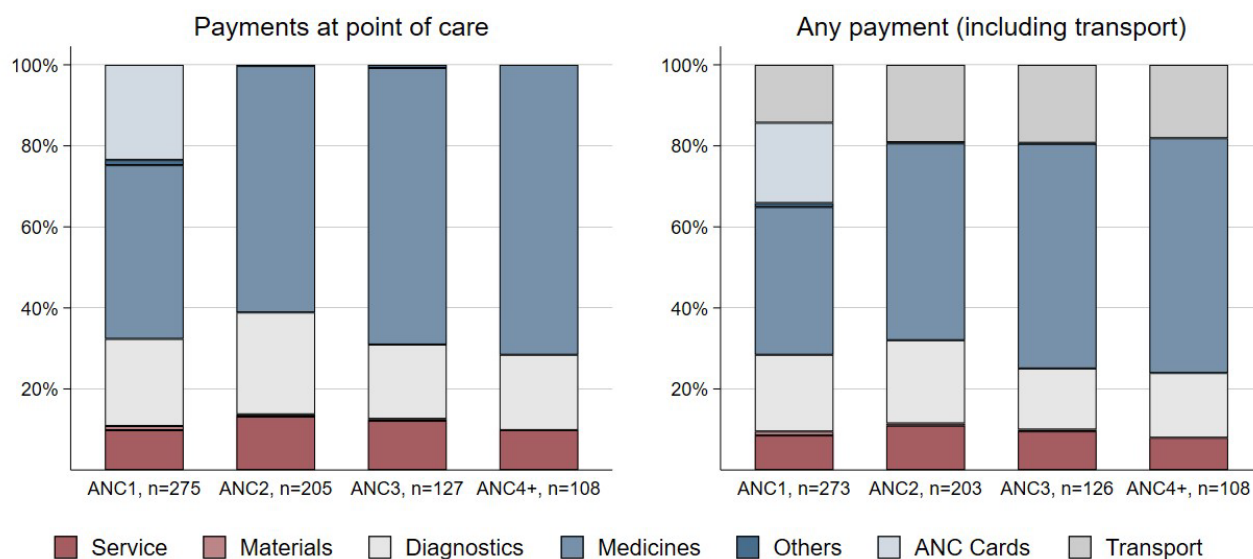## Out-of-pocket payments for ANCs: Distributions of cost categories

Figure 8: Distribution of out-of-pocket payments for antenatal care (ANC) over cost categories, by number of ANC consultation.

For the assessment of OOPs for births, we interviewed 1,441 HDSS-registered women who had given birth since the last HDSS visit. Among them, 60% (n=864) reported having had a health system contact in the perinatal period: 56% (n=803) gave birth at a health facility, and 4% (n=61) at home but sought PNC immediately after birth. 40% (n=577) of the women gave birth at home without an immediate PNC contact (Supplementary Table 10). Supplementary Table 10 and Supplementary Table 11 display the background characteristics of the analytical sample.

A total of 84-86% of the women with a perinatal care contact reported point-of-care OOPs (facility births: 688/803, 86%; home births with PNC sought: 51/61, 84%); 92-93% any OOPs (facility births: 750/803, 93%; home births with PNC sought: 56/61, 92%). Among the women who gave birth at home, 52% (299/577) reported any OOPs (Figure 9).

Prevalence of out-of-pocket payments for births

Payments at point of care
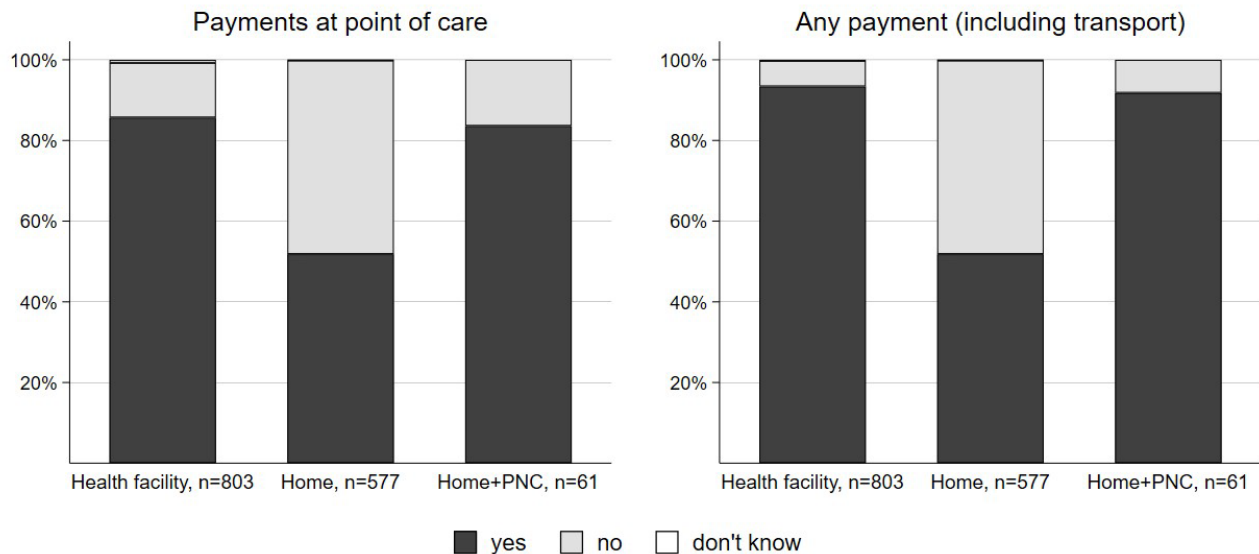

Any payment (including transport)

Figure 9: Prevalence of out-of-pocket payments for birth, by place of birth. PNC=postnatal care sought immediately after birth.

Across the assessed background factors, for facility births, the prevalence of OOPs was higher among women from households allocated to the poorest group, women with no schooling, primigravidae, and women below 20 years of age. There were also substantial regional variations. Further, OOPs for facility births tended to be more prevalent when the nearest health facility was not in close proximity to the woman's residency, and when care was sought at private or faith-based health facilities, the National Hospital Simão Mendes, or at health facilities abroad (Supplementary Table 12, Supplementary Table 13, Supplementary Table 14, Supplementary Table 15).

Reported point-of-care OOPs for facility births amounted to a median of 4,000 XOF (IQR 400-9,000 XOF) (6€ (IQR 0.61-14€)); total OOPs to 6,000 XOF (IQR 2,000-11,000 XOF) (9€ (IQR 3-17€)). Median point-of-care OOPs for home births with a subsequent PNC contact were reported at 2,500 XOF (IQR 50-5,000 XOF) (4€ (IQR 0.08-8€)); total OOPs at 4,150 XOF (IQR 1,000-6,025 XOF) (6€ (IQR 2-9€)). Median total OOPs in relation to home births without any perinatal care contact were reported at 50 XOF (IQR 0-200 XOF) (0.08€ (IQR 0-0.30€)) (Figure 10).

Restricting the assessment to facility births at public health centres and regional hospitals (exclusion of facility births at the National Hospital Simão Mendes, private/faith-based health centres and health facilities aboard) yielded similar point-of-care OOP at a median of 4,000 XOF (IQR 150-7,750 XOF) (6€ (IQR 0.23-12€)) and similar total OOPs at a median of 6,000 XOF (IQR 2,000-10,000 XOF) (9€ (IQR3-15€)) (data not shown).
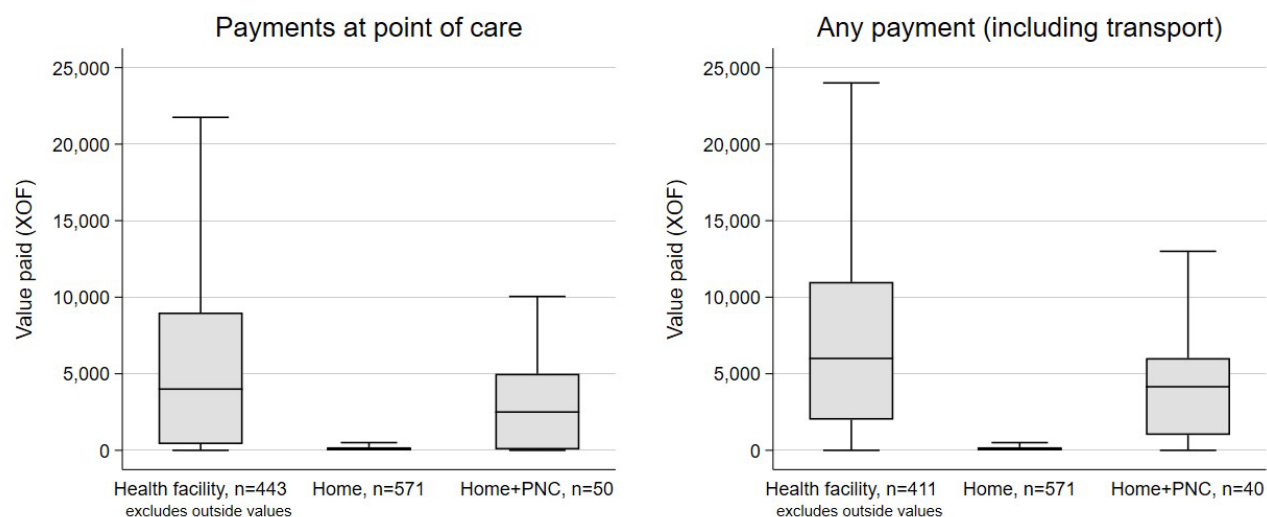
Figure 10: Level of out-of-pocket payments for birth (median with inter-quartile range (box) and range), by place of birth. PNC=postnatal care sought immediately after birth.

Payments for medicine accounted for around half of the total OOPs for women with facility births (on average 45%), followed by transportation (22%), and service provision (18%) (Figure 11). For homebirths with PNC sought, the distribution of cost categories shifted but medicines continued to account for the highest proportions of total OOPs (31%), followed by materials (22%), and transportation (19%). In addition, 'other costs' accounted for a substantial proportion of total OOPs for homebirths with PNC sought (12%). These were mostly financial penalties charged at the health facilities for giving birth at home. In contrast, for homebirths without any perinatal care contact, materials accounted for the highest proportion of total OOPs (60%) (Figure 11); here, a razorblade and a thread were the materials most commonly purchased (data not shown).

Out-of-pocket payments for births: Distributions of cost categories
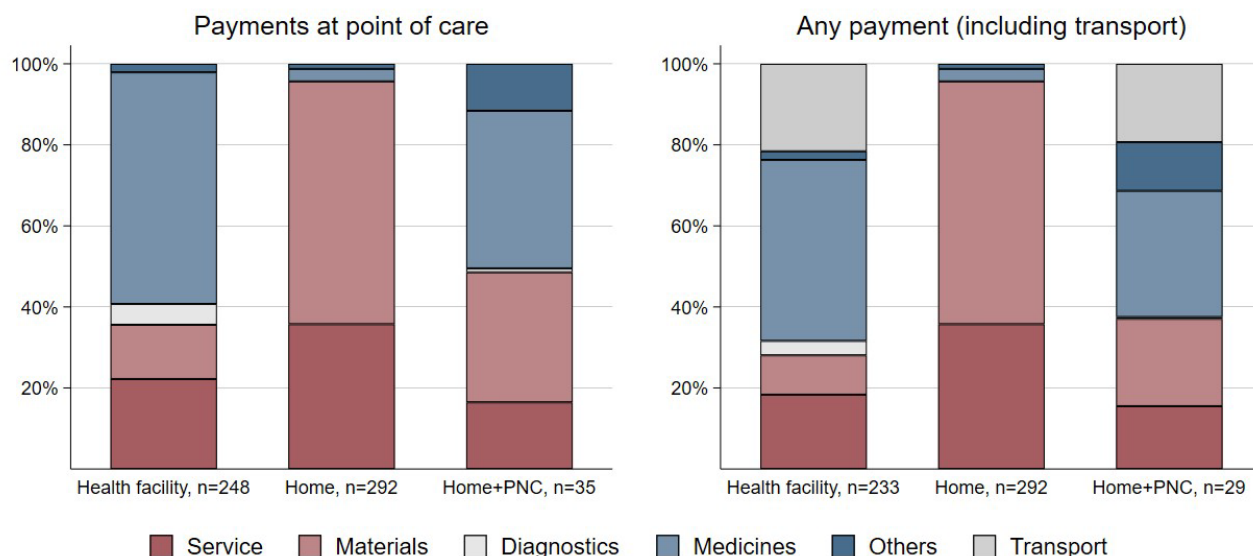
Figure 11: Distribution of out-of-pocket payments for birth over cost categories, by place of birth. PNC=postnatal care sought immediately after birth.

4.4. Health facility characteristics

Among the 35 health centres where we collected information on health facility characteristics, most (89%, n=31) were type C; no type A health centres were included. All but two health centres were open every day (7 days per week) and provided emergency care 24 hours a day. The two remaining health centres were located near a regional hospital and only opened during weekdays. These health centres also reported to not provide emergency care. Health staff also reported that the provision of ANC and facility births was free of charge (Table 8).

Table 8: Results of the health facility survey implemented at 35 health facilities in Bafatá, Biombo and Oio, January-April 2023.

	Region			
	Bafatá	**Biombo**	**Oio**	**Total**
	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)
Total sample	14 (40)	7 (20)	14 (40)	35 (100)
Type of health centre				
B	2 (15)	1 (14)	1 (7)	4 (11)
C	12 (85)	6 (86)	13 (93)	31 (89)
Emergency care (number of days/week)				
0	1 (7)	0	1 (7)	2 (6)
7	13 (93)	7 (100)	13 (93)	33 (94)
ANC consultations (number of days/week)				
5	12 (86)	6 (86)	13 (93)	31 (89)
7	2 (14)	1 (14)	1 (7)	4 (11)
Waiting time for ANC consultations (hours)				
< 2	7 (50)	2 (29)	8 (57)	17 (49)
>= 2	7 (50)	5 (71)	6 (43)	18 (51)
Waiting time for women in labour (hours)				
0	14 (100)	7 (100)	14 (100)	35 (100)
ANC consultation price XOF (EUR)				
0	14 (100)	7 (100)	14 (100)	35 (100)
ANC card price XOF (EUR)				
0	9 (64)	5 (72)	12 (86)	26 (74)
500 (0.76)	0	1 (14)	1 (7)	2 (6)
1000 (1.52)	4 (29)	0	1 (7)	5 (14)
Unfixed /unknown	1 (7)	1 (14)	0	2 (6)
Tetanus card price XOF (EUR)				
0	14 (100)	6 (86)	13 (93)	33 (94)
500 (0.76)	0	1 (14)	1 (7)	2 (6)
Children's vaccines price XOF (EUR)				
0	14 (100)	7 (100)	14 (100)	35 (100)
Child vaccination card price XOF (EUR)				
0	10 (71)	3 (43)	13 (93)	26 (74)
500 (0.76)	0	2 (29)	1 (7)	3 (9)
1000 (1.52)	3 (21)	1 (14)	0	4 (11)
Unfixed /unknown	1 (8)	1 (14)	0	2 (6)
Delivery assistance price (XOF/EUR)				
0	14 (100)	7 (100)	14 (100)	35 (100)
Emergency evacuation vehicles				
No	11 (79)	1 (14)	9 (64)	21 (60)
Yes	3 (21)	6 (86)	5 (36)	14 (40)

Type of emergency vehicles				
Ambulance	3	5	2	10
Motorcycle	0	1	3	4
Evacuation transportation price XOF (EUR)				
0	14 (100)	7 (100)	14 (100)	35 (100)
Health centre performs ultrasound				
No	13 (93)	6 (86)	14 (100)	33 (94)
Yes	1 (7)	1 (14)	0	2 (6)
Pre-/postpartum room exclusively for women				
No	4 (31)	0	2 (15)	6 (18)
Yes	9 (69)	7 (100)	11 (85)	27 (82)
Quality of infrastructure (rated by health staff responsible for the health facility)				
Reasonable	9 (64)	3 (43)	6 (43)	18 (51)
Good	4 (29)	3 (43)	8 (57)	15 (43)
Very good	1 (7)	1 (14)	0	2 (6)

A lack of one or more essential instruments and consumables was common. More than half of the health facilities reported lacking blood-pressure meters (Figure 12). Furthermore, half of the health facilities reported lacking ANC cards, and some interviewees explained that therefore, they had to produce the cards themselves. This, in turn, entailed expenses which were passed onto patients by selling the cards.
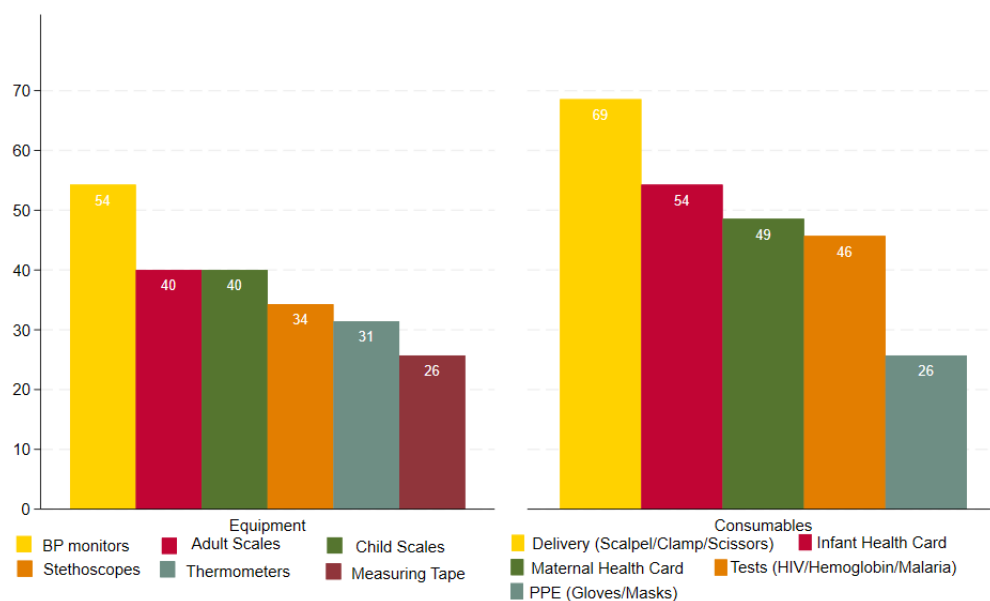

Figure 12: Reported working instruments missing or considered insufficient (Equipment and Consumables).

Our multilevel models included 3,419 children for ANC4, and 3,682 children for facility births. In the preliminary analyses, we found that distance and facility-reported perceived quality of health centre infrastructure, cost of the ANC card, evacuation vehicles, parity, season of the year, maternal household assets, maternal education, age, ethnicity, and history of facility delivery were associated with ANC4 and facility birth coverage. Health facility/village characteristics seemed to explain more of the variation than lower-level variables did. The results of the multilevel models are provided in Supplementary Tables 16 and 17.

5. DISCUSSION

5.1. Main findings

In this report, we found that in 2023, mortality of both women of reproductive age and children below the age of 5 years remained very high. Meanwhile, coverage of most of the assessed essential MCH services remained largely inadequate. While ANC1 coverage was close to universal, only slightly more than half of the pregnant women obtained ANC4 and facility births, and slightly less obtained PNC within 24 hours after birth. Coverage of ANC8, reflecting the currently recommended number of ANCs, was very low at 6%. At the same time, we detected important gaps in the cascade of facility-based perinatal care: among women who gave birth at a health facility, ~1 in 5 did not remain at the health facility for the recommended minimum of 24 hours (postpartum admission) nor obtained PNC within 24 hours postpartum.

Background factors associated with higher coverage differed between the outcomes. We found a pronounced negative association between coverage of ANC, facility births and PNC (assessed among all births) and distance to the nearest health facility. Further, we found pronounced heterogeneities between regions and ethnic groups across the outcomes. We also observed coverage of ANC4 and PNC to be statistically significantly associated with household wealth with all other outcomes showing the same tendency except for postpartum admission, which had the opposite tendency of higher coverage in women from poorer households. Similarly, higher maternal schooling was associated with higher coverage for most outcomes except for postpartum admission and PNC among facility births, which showed the opposite tendency. Women who had given birth before had considerably lower coverage rates of facility births and PNC (among all births) in comparison with primigravidae. We observed the same for ANC4 in grand multipara. At the same time, we found a mixed pattern for maternal age: In comparison with teenage women, older women tended to be more likely to obtain ANC4, ANC8 and,

among facility births, PNC, but were statistically significantly less likely to obtain facility births, with a similar tendency for PNC among all births.

Furthermore, we found OOPs for essential MCH services to be highly prevalent with 81% of the interviewed women with an ANC contact and 86% of the women with a facility birth reporting point-of-care OOPs. The prevalences increased to 90% and 93%, respectively, when taking expenses for transportation into account. Reported point-of-care OOPs amounted to a median of 2,000 XOF for ANC and 4,000 XOF for facility births, and total OOPs to a median of 3,000 XOF and 6,000 XOF, respectively. In contrast, median OOPs for homebirths amounted to 50 XOF.

The reported experiences of pregnant and birthing women stand in contrast to the information obtained during the health facility interviews. Here health staff stated that the provision of ANC and facility births was free of charge, but also reported lack of several supplies. Further, some health facilities reported the necessity of selling ANC cards when they had run out of the provided cards and therefore had to produce the cards themselves.

5.2.   Interpretation and implications

Though mortality remains high, mortality is a rare outcome and consequently, the precision of the estimates, as reflected in the 95%CIs, is limited. Hence, we do not have sufficient statistical power to identify smaller differences across background factors. Nevertheless, in comparison with our prior report (18), we see no indication of the previously observed improvement in mortality of women of reproductive age between 2018-23 being reversed.

For child mortality, we observed a persistently high under-5, infant, and neonatal mortality with levels similar to what we have previously observed between 2018-23 (18). While the perinatal mortality appeared slightly lower, the 95%CI of the estimate impedes firm conclusions on a change. The background factors associated with perinatal mortality were similar to what we have identified previously (16, 18) and are also in line with the literature (22).

Overall, coverage of most assessed essential MCH services was inadequate in rural Guinea-Bissau during the assessed period with levels similar to what we have previously observed between 2018-23 (18). This is likely largely determined by the persistence of barriers to care and related accessibility and availability constraints. Here, our present assessments of OOPs provide strong indications of a persistence of financial accessibility constraints despite formal user-fee waivers, with OOPs at the point of care being reported by the vast majority of women. This was the case both for women with ANC and

with peripartum health facility contacts. In this context, it is important to note that provided estimates on OOP prevalences and levels are conservative. This is because OOP prevalences do not account for women who avoided care seeking due to the OOPs or other reasons. Furthermore, OOP levels do not account for charges women were unable or unwilling to pay and women may have forgone e.g., seeking recommended diagnostics or purchasing prescribed medicine depending on their affordability. The persistence of OOPs for essential MCH services is structurally disadvantaging women from poorer households. Accordingly, we also found higher coverage rates among women from households allocated to the richest group for most outcomes, which is in line with previous research both from Guinea-Bissau (18, 23) and elsewhere (24, 25). We have already previously documented the persistence of OOPs despite formal user-fee-waivers during PIMI II (17, 26, 27), with our findings being also in line with a previous assessment of demand-side barriers to MCH services by the World Bank (28).

In our present study, medicines accounted for the highest share of reported OOPs for ANC and facility births. Considering that essential medicines for ANC and peripartum care are formally provided free of charge at all public health facilities in rural Guinea-Bissau, three key reasons may determine the persistence of related OOPs:

1. Prescription of medicine not covered by user fee waivers;
2. stock outs of free-of-charge medicine; and
3. the imposition of illicit charges.

Similar reasons may also explain the prevalence of OOPs for other cost categories. In this context, volatile health worker remuneration and deficits of financial resources for routine health facility expenses may contribute to survival corruption. Regardless of why the OOPs occur, the persistence of OOPs despite PIMI's implementation is highly alarming and entails severe equity concerns. Hence, further investigations of reasons for their persistence are urgently required to inform interventions ensuring the effective abolition of payments and equitable access to essential MCH services.

In addition to financial barriers to care, we found a pronounced negative association between the coverage of most of the assessed essential MCH services and distance to the nearest health facility, reflecting the persistence of geographical barriers to care. Regional heterogeneities with higher coverage of ANCs, facility births and PNC (among all births) being observed on Bolama/Bubaque may be due to an easier geographical accessibility of health facilities in this area, where the HDSS village clusters tend to be relatively close to health facilities, and have also previously been observed (18). Meanwhile, both geographical and financial barriers to MCH services have also been indicated as key

barriers to care both during PIMI II and the transition period in our previous evaluation (17, 26, 27), as well as in the World Bank's assessment of barriers to MCH services in 2019 (28).

The pattern of higher coverage rates of facility births and PNC (among all births) in primigravidae compared with multiparous women is in line with a similar pattern regarding facility births highlighted in our previous report (18). According to our previous findings from qualitative inquiries (26, 27), this pattern may be due to a differential risk perception among women and their families depending on previous birthing experiences which appears to determine differential prioritisations of household finances to overcome demand-side barriers to care. Here, "unexperienced" women, i.e., primipara, seem to be prioritised. This pattern is further consistent with lower coverage of facility births and PNC among older women, as also observed in relation to facility births in our previous report (18). Yet, for ANC4 and ANC8, we found a reversed pattern and older age groups were more likely to obtain ANC4 and ANC8 in comparison with the youngest group, which may be due to women in these age groups using ANC to assess their perceived need for a facility birth, i.e., to determine their risk of having birthing complications. Alternatively, the pattern could also be determined by older women starting ANCs earlier and therefore being more likely to obtain more visits before delivery. Further research is needed to explore and understand the mechanisms determining this pattern.

Our findings also reflect crucial gaps in the continuum of care of facility-provided services: Among women who gave birth at a health facility, one in five did not obtain the recommended postpartum observation of at least 24 hours after birth (postpartum admission), nor timely PNC within 24 hours after birth. An increased focus on attaining higher coverage of these services appears, however, a low-hanging fruit given that the women are already at the health facility. In this context, the tendency of women from households allocated to the poorest group having a higher coverage of postpartum admission is surprising and requires further exploration.

Persistently high mortality rates alongside the persistence of pronounced gaps between need and utilisation of most of the assessed essential MCH services in rural Guinea-Bissau urgently calls for further targeted measures to improve MCH service coverage and promote universal health coverage. While not explicitly studied in the present work, we acknowledge that there are numerous stakeholders and intervening organisations in the Bissau-Guinean MCH service delivery landscape. Since all act in the same health system, which is characterised by a limited health workforce, integration of services and interventions is essential to ensure that health impact is optimised.

5.3.   Strengths and limitations

This evaluation is based on BHP's nationally representative rural HDSS which monitors pregnancies, births, the uptake of essential MCH services, and deaths in a nationally representative cohort in rural Guinea-Bissau. The monitored cohort is fully targeted by PIMI. Thereby, BHP's rural HDSS provides population-based information on service coverage and mortality among both users and non-users of formal health services promoted by PIMI independent of health-facility data. By being collected independently from health facilities, our estimates are not subject to principal-agent problems and associated potential strategic reporting.

To assess mortality throughout 2023, all individuals under surveillance must have had a visit after 31st December 2023. Due to HDSS logistics, information on some individuals was not yet available at the time of reporting. While some information on 6% of the women and 4% of the children is still due, this only affects a smaller proportion of the observation time as information from the previous visits in 2023 is fully available. Furthermore, the missing observation time has little impact on the estimated mortality levels: by reporting mortality levels as rates and using Kaplan-Meier estimates, we have accounted for the observed person years in the analyses.

Our ANC, facility birth, postpartum admission and PNC coverage as well as OOP estimates are based on retrospectively collected information obtained from household interviews and, for ANC, from both HDSS household interviews and ANC cards. Recall and/or social desirability bias may limit the accuracy of the estimates based on household interview information. Indeed, when limiting the ANC coverage assessment to information obtained from an ANC card, ANC4 coverage was 50% and ANC8 coverage 3% vs. the 62% (ANC4) and 6% (ANC8) estimates based on information from either recall or ANC cards (i.e., our estimates from the main analysis). Hence, our coverage estimates may be too optimistic. While the presence and direction of potential biases in the reported OOPs cannot be assessed due to a lack of alternative data sources, during the related field work, we observed that women often reported specific values without hesitation and were able to provide detailed explanations on the circumstances of their imposition, suggesting that recall bias is likely limited.

In addition, in the estimation of facility birth coverage, we did not discriminate between births taking place in public health facilities in Guinea-Bissau vs. private/faith-based facilities or abroad. While our facility birth coverage estimates may therefore be higher than programme estimates, differences are likely minor. In our assessments of point-of-care OOP levels, we conducted sensitivity analyses restricting the assessments to care obtained in Bissau-Guinean public health centres and regional

hospitals and, for ANC, care obtained during their community outreach. Thereby, we excluded interviews on care sought at private/faith-based health centres, the National Hospital Simão Mendes, and health facilities aboard. These sensitivity analyses yielded similar OOP levels as the main analyses.

In the coverage assessments, it is also important to note that the timing of the actual service provision differs between the assessed outcomes. All coverage analyses were based on the defined birth cohort, delimited by the children's date of birth taking place in the calendar year 2023. While the provision of peripartum care thereby coincides with the cohort delimitations, some pregnancies may have commenced ANC in the weeks before the implementation of PIMI III. In the estimation of vaccination coverage, our cohort is small since coverage is here measured by 12 months of age among children with card inspected between 12 and 23 months of age. As this timeframe is still ongoing for the birth cohort assessed in this report, we were not yet able to present a full picture of the vaccination coverage among these children at the time of reporting.

Furthermore, the analyses assessing differential perinatal mortality, coverage and OOP prevalences across background factors are univariate analyses. Importantly, there could be both measured and unmeasured confounders explaining the associations which have not been considered for the present work. Moreover, there may be imprecision in the assessment of maternal education, which is assessed at registration of the woman and not at childbirth.

While the health facility survey disclosed that a large proportion of the surveyed health facilities were lacking materials essential to provide adequate care, the unanimously supply-side reported free-of-charge service provision stands in stark contrast to women's accounts of point-of-care OOPs. This emphasises the importance of investigating both supply- and demand-side perspectives.

6. RECOMMENDATIONS

A persistent high child and perinatal mortality and inadequate coverage of most of the essential MCH services assessed in this report call for further action promoting the coverage of essential and potentially lifesaving MCH services in rural Guinea-Bissau. The high prevalence of OOPs for essential MCH services is alarming and raises severe concerns regarding the financial accessibility of services and health equity. Immediate action should thus focus on assuring the gratuity of essential MCH services including prescribed medicines and utilised materials as a foundation to promote coverage of essential MCH services and equity in coverage. To this end, further research investigating the reasons for the persistence of point-of-care OOPs despite formal user-fee waivers is essential to ensure the design of

effective interventions. At the same time, measures promoting geographical access to care and reducing OOPs for transportation need to be prioritised. Meanwhile, increasing the coverage of the assessed recommended PNC interventions among facility births is a low-hanging fruit and should be prioritised. To this end, appropriate framework conditions including sufficient human resources and equipment are key enablers and their adequate availability at rural health facilities needs to be ensured. Continuous rigorous monitoring and evaluation focusing on both the developments of OOP prevalences and levels, coverage, equity and impact on mortality is key to ensure that implemented measures achieve their anticipated effects.

7. CONCLUSION

During the implementation of PIMI III, coverage of most of the assessed essential MCH services was largely inadequate in rural Guinea-Bissau while mortality of women of reproductive age and children was high. Since barriers to care and compromised accessibility and availability of quality health services are likely decisive, there is a high need for targeted measures to improve the coverage of quality MCH services and promote universal health coverage across the country. In this context, one key concern is a very high prevalence of OOPs for essential MCH services despite their formal gratuity. Entailing severe equity concerns, gratuity of essential MCH services including provided medicines and consumables need to be urgently ensured. This, in turn, requires in-depth investigations of related root causes to inform adequate and effective countermeasures. By ensuring the Bissau-Guinean population's access to quality MCH services, the persistently high mortality may eventually decline.

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SUPPLEMENTARY MATERIAL

Supplementary Table 1: Mortality rates during by age groups, between January and December 2023.

	Deaths / Observation time (Person years)	Mortality rates per 1,000 person years (95%CI)
Neonatal	99 / 224	442.5 (345.3-578.1)
1-11 months	88 / 2,984	29.5 (23.8-37.0)
12-59 months	59 / 12,017	4.9 (3.8-6.4)

Supplementary Table 2: Maternal background characteristics of the analytical sample for perinatal mortality.

	Total	Missings / N (%)
n (%)	3,026 (100)	0/3,026 (0)
Household assets		77/3,026 (3)
0-2 items	177 (6)	
3-4 items	1,185 (40)	
5 items	1,587 (54)	
Maternal education		70/3,026 (2)
No schooling	1,101 (37)	
Primary school	917 (31)	
Secondary or higher	938 (32)	
Parity		8/3,026 (0)
Primigravida	596 (20)	
1-3 prior births	1,488 (49)	
4+ prior births	934 (31)	
Maternal age		27/3,026 (1)
<20	1,503 (50)	
20-24	798 (27)	
25-29	456 (15)	
30-34	168 (6)	
35+	74 (2)	
Region		0/3,026 (0)
Oio	577 (19)	
Biombo	421 (14)	
Gabu	423 (14)	
Cacheu	442 (15)	
Bafatá	427 (14)	
Quinara	258 (9)	
Tombali	283 (9)	
Bolama/Bubaque	105 (3)	
Farim	90 (3)	
Ethnicity		7/3,026 (0)
Balanta	903 (30)	
Fula/Mandinga	1,254 (42)	
Manjaco/Mancanha	122 (4)	
Pepel	346 (11)	
Beafada	172 (6)	
Bijagós	61 (2)	
other	161 (5)	
Distance to nearest HF		0/3,026 (0)
<2 km	751 (25)	
2-5 km	630 (21)	

5-8 km	894 (30)
>8 km	751 (25)

Supplementary Table 3: Perinatal mortality across background factors.

	Perinatal death	
	Mortality (n/N)	OR (95%CI)
Overall	72 (219/3,026)	
Household assets		
0-2 items	40 (7/177)	Ref.
3-4 items	73 (87/1,185)	1.94 (0.83-4.57)
5 items	74 (117/1,587)	1.95 (0.84-4.52)
Maternal education		
No schooling	88 (97/1,101)	Ref.
Primary school	71 (65/917)	0.77 (0.56-1.05)
Secondary or higher	58 (54/938)	0.61 (0.44-0.86)
Parity		
Primigravida	99 (59/596)	Ref.
1-3 prior births	51 (76/1,488)	0.49 (0.34-0.71)
4+ prior births	90 (84/934)	0.90 (0.63-1.29)
Maternal age		
<20	75 (112/1,503)	Ref.
20-24	46 (37/798)	0.60 (0.41-0.89)
25-29	99 (45/456)	1.36 (0.97-1.90)
30-34	101 (17/168)	1.40 (0.81-2.42)
35+	81 (6/74)	1.10 (0.46-2.60)
Region		
Oio	92 (53/577)	Ref.
Biombo	55 (23/421)	0.55 (0.33-0.94)
Gabu	87 (37/423)	0.90 (0.61-1.35)
Cacheu	57 (25/442)	0.57 (0.34-0.96)
Bafatá	68 (29/427)	0.69 (0.45-1.06)
Quinara	78 (20/258)	0.80 (0.50-1.27)
Tombali	74 (21/283)	0.77 (0.46-1.29)
Bolama/Bubaque	67 (7/105)	0.68 (0.33-1.40)
Farim	44 (4/90)	0.47 (0.26-0.84)
Ethnicity		
Balanta	54 (49/903)	Ref.
Fula/Mandinga	90 (113/1,254)	1.73 (1.24-2.40)
Manjaco/Mancanha	41 (5/122)	0.74 (0.34-1.62)
Pepel	64 (22/346)	1.18 (0.73-1.90)
Beafada	93 (16/172)	1.77 (1.08-2.90)
Bijagós	66 (4/61)	1.19 (0.43-3.29)
other	62 (10/161)	1.14 (0.60-2.18)
Distance to nearest HF		
<2 km	8 (58/751)	Ref.

2-5 km	6 (37/630)	0.75 (0.50-1.12)
5-8 km	6 (55/894)	0.78 (0.56-1.08)
>8 km	9 (69/751)	1.29 (0.91-1.83)

Supplementary Table 4: Coverage of any, four or more and eight or more antenatal care consultations (ANC1/ANC4/ANC8) across background factors.

	ANC1		ANC4		ANC8	
	% (n/N)	OR (95%CI)	% (n/N)	OR (95%CI)	% (n/N)	OR (95%CI)
Overall	99 (3,515/3,549)		62 (1,630/2,641)		6 (146/2,641)	
Household assets						
0-2 items	98 (213/217)	Ref.	49 (81/167)	Ref.	4 (6/167)	Ref.
3-4 items	99 (1,345/1,361)	1.75 (0.44-7.02)	59 (598/1,010)	1.47 (1.04-2.06)	4 (41/1,010)	1.35 (0.61-3.00)
5 items	99 (1,854/1,868)	2.61 (0.70-9.68)	65 (906/1,392)	1.67 (1.14-2.44)	7 (96/1,392)	2.01 (0.88-4.61)
Maternal education						
No schooling	98 (1,216/1,236)	Ref.	53 (514/964)	Ref.	3 (25/964)	Ref.
Primary school	99 (1,066/1,073)	2.34 (0.89-6.10)	61 (486/800)	1.17 (0.96-1.43)	5 (42/800)	1.68 (1.11-2.56)
Secondary or higher	99 (1,149/1,155)	2.94 (1.07-8.05)	73 (602/821)	1.76 (1.39-2.22)	10 (78/821)	2.84 (1.89-4.28)
Parity						
Primigravida	99 (777/783)	Ref.	66 (370/558)	Ref.	7 (37/558)	Ref.
1 prior birth	99 (636/640)	1.45 (0.27-7.69)	66 (303/462)	0.99 (0.74-1.33)	8 (36/462)	1.25 (0.78-2.01)
2-3 prior births	99 (1,064/1,076)	0.71 (0.25-2.03)	62 (500/813)	0.85 (0.67-1.09)	5 (42/813)	0.88 (0.55-1.41)
4+ prior births	99 (1,017/1,029)	0.69 (0.20-2.35)	56 (444/794)	0.71 (0.55-0.92)	4 (29/794)	0.66 (0.42-1.05)
Maternal age						
<20	99 (533/537)	Ref.	58 (245/425)	Ref.	4 (17/425)	Ref.
20-24	99 (949/960)	0.57 (0.11-2.84)	64 (433/679)	1.24 (0.95-1.61)	7 (49/679)	1.75 (1.06-2.90)
25-29	99 (876/886)	0.56 (0.11-2.93)	62 (406/660)	1.12 (0.83-1.51)	6 (41/660)	1.47 (0.85-2.54)
30-34	99 (668/675)	0.59 (0.12-2.94)	61 (306/503)	1.03 (0.76-1.38)	4 (18/503)	0.89 (0.48-1.63)
35+	100 (442/444)	1.28 (0.23-7.04)	64 (218/339)	1.10 (0.77-1.55)	5 (18/339)	1.21 (0.68-2.15)
Region						
Oio	98 (613/627)	Ref.	45 (216/483)	Ref.	2 (8/483)	Ref.
Biombo	99 (476/483)	1.41 (0.46-4.39)	66 (249/376)	2.21 (1.43-3.40)	7 (25/376)	4.13 (1.81-9.43)
Gabu	99 (487/492)	2.18 (0.76-6.24)	55 (204/372)	1.57 (0.94-2.64)	1 (5/372)	0.95 (0.30-2.94)
Cacheu	100 (588/590)	6.89 (1.64-28.93)	71 (305/429)	3.05 (2.04-4.58)	8 (35/429)	5.11 (2.19-11.91)
Bafatá	100 (468/470)	5.12 (1.23-21.27)	66 (232/354)	2.19 (1.42-3.38)	9 (32/354)	6.38 (2.36-17.27)
Quinara	99 (299/302)	2.28 (0.32-16.45)	68 (148/218)	2.49 (1.35-4.58)	3 (7/218)	1.97 (0.64-6.05)
Tombali	100 (352/352)	1.00 (.-.)	61 (153/249)	1.77 (1.04-3.01)	5 (12/249)	2.82 (1.10-7.23)

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						7.12 (3.48-14.59)
Bolama/Bubaque	100 (143/143)	1.00 (.-.)	86 (69/80)		20 (16/80)	14.59 (5.52-38.61)
Farim	99 (89/90)	2.10 (0.53-8.34)	68 (54/80)	2.38 (1.57-3.60)	8 (6/80)	6.38 (1.23-33.02)
Ethnicity						
Balanta	99 (1,094/1,104)	Ref.	56 (451/809)	Ref.	5 (41/809)	Ref.
Fula/Mandinga	99 (1,364/1,381)	0.69 (0.26-1.81)	57 (618/1,081)	1.08 (0.79-1.49)	4 (47/1,081)	1.04 (0.56-1.92)
Manjaco/Mancanha	100 (174/174)	1.00 (.-.)	86 (95/111)	3.60 (2.00-6.49)	10 (11/111)	2.15 (1.09-4.24)
Pepel	98 (391/398)	0.38 (0.11-1.30)	68 (206/303)	1.45 (0.97-2.19)	7 (21/303)	1.27 (0.74-2.18)
Beafada	100 (184/184)	1.00 (.-.)	84 (109/130)	3.78 (2.00-7.13)	2 (3/130)	0.49 (0.20-1.23)
Bijagós	100 (86/86)	1.00 (.-.)	85 (40/47)	2.97 (1.43-6.18)	19 (9/47)	4.21 (1.61-11.03)
other	100 (203/203)	1.00 (.-.)	70 (100/143)	1.45 (0.89-2.37)	9 (13/143)	1.88 (0.88-4.03)
Distance to nearest health facility						
<2 km	100 (923/927)	Ref.	73 (501/682)	Ref.	9 (58/682)	Ref.
2-5 km	99 (727/732)	0.65 (0.20-2.17)	62 (332/538)	0.54 (0.37-0.79)	6 (30/538)	0.63 (0.33-1.22)
5-8 km	99 (1,013/1,028)	0.30 (0.09-0.97)	57 (444/776)	0.54 (0.38-0.77)	4 (28/776)	0.44 (0.24-0.79)
>8 km	99 (852/862)	0.42 (0.12-1.45)	55 (353/645)	0.50 (0.35-0.72)	5 (30/645)	0.50 (0.26-0.95)

Supplementary Table 5: Coverage facility births and postpartum admission across background factors.
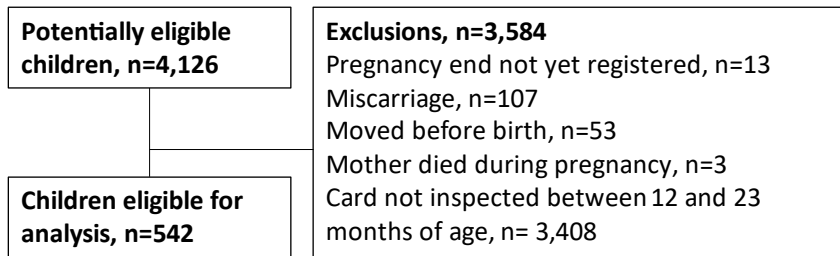
	Facility births		Postpartum admission	
	% (n/N)	OR (95%CI)	% (n/N)	OR (95%CI)
Overall	58 (2,097/3,599)		81 (1,468/1,816)	
Household assets				
0-2 items	53 (118/223)	Ref.	83 (85/102)	Ref.
3-4 items	57 (783/1,381)	1.18 (0.88-1.56)	83 (558/675)	1.03 (0.58-1.81)
5 items	60 (1,123/1,886)	1.33 (1.00-1.76)	79 (775/975)	0.83 (0.47-1.47)
Maternal education				
No schooling	48 (597/1,250)	Ref.	84 (439/525)	Ref.
Primary school	58 (630/1,086)	1.35 (1.15-1.59)	80 (439/546)	0.80 (0.58-1.09)
Secondary or higher	70 (829/1,176)	1.97 (1.69-2.29)	79 (561/709)	0.78 (0.57-1.06)
Parity				
Primigravida	80 (635/798)	Ref.	80 (436/547)	Ref.
1 prior birth	60 (388/642)	0.42 (0.33-0.54)	80 (274/341)	1.05 (0.77-1.42)
2-3 prior births	49 (537/1,094)	0.27 (0.21-0.34)	79 (368/464)	0.96 (0.73-1.26)
4+ prior births	50 (520/1,043)	0.31 (0.24-0.40)	84 (377/451)	1.22 (0.87-1.72)
Maternal age				
<20	68 (372/546)	Ref.	82 (268/325)	Ref.
20-24	59 (578/975)	0.63 (0.49-0.80)	80 (394/494)	0.85 (0.58-1.23)
25-29	54 (489/899)	0.47 (0.36-0.61)	82 (354/430)	1.00 (0.67-1.50)
30-34	57 (388/680)	0.56 (0.43-0.73)	78 (257/330)	0.76 (0.50-1.14)
35+	53 (238/449)	0.45 (0.34-0.59)	82 (172/210)	0.96 (0.59-1.57)
Region				
Oio	39 (255/647)	Ref.	87 (187/215)	Ref.
Biombo	71 (356/503)	3.11 (1.77-5.47)	80 (257/320)	0.59 (0.38-0.93)
Gabu	56 (280/496)	2.00 (1.10-3.64)	86 (230/267)	0.89 (0.53-1.49)
Cacheu	58 (337/584)	2.13 (1.23-3.70)	73 (200/275)	0.39 (0.23-0.63)
Bafatá	57 (270/473)	1.94 (1.03-3.69)	68 (163/240)	0.30 (0.18-0.52)
Quinara	64 (197/307)	2.72 (1.46-5.05)	84 (135/160)	0.76 (0.42-1.37)
Tombali	61 (216/355)	2.18 (1.21-3.93)	87 (162/186)	0.98 (0.50-1.92)
Bolama/Bubaque	96 (137/143)	28.77 (11.93-69.39)	85 (92/108)	0.83 (0.35-2.00)
Farim	54 (49/91)	1.99 (0.83-4.75)	93 (42/45)	2.08 (0.85-5.08)
Ethnicity				
Balanta	46 (521/1,122)	Ref.	82 (359/438)	Ref.
Fula/Mandinga	56 (784/1,396)	1.33 (1.02-1.72)	81 (580/712)	1.03 (0.71-1.47)
Manjaco/Mancanha	73 (124/170)	1.93 (1.34-2.79)	62 (63/101)	0.40 (0.25-0.65)
Pepel	71 (294/416)	1.71 (1.30-2.24)	79 (208/262)	0.84 (0.56-1.26)
Beafada	75 (141/187)	3.93 (2.10-7.35)	87 (99/114)	1.46 (0.84-2.54)
Bijagós	87 (76/87)	2.84 (1.50-5.39)	98 (58/59)	11.24 (1.42-89.27)
other	72 (145/202)	1.59 (1.03-2.44)	77 (91/118)	0.76 (0.44-1.31)

Distance to nearest health facility				
<2 km	82 (771/938)	Ref.	80 (543/682)	Ref.
2-5 km	58 (430/746)	0.27 (0.18-0.40)	79 (294/372)	1.00 (0.68-1.49)
5-8 km	46 (476/1,043)	0.19 (0.14-0.27)	83 (338/406)	1.28 (0.85-1.94)
>8 km	48 (420/872)	0.19 (0.13-0.27)	82 (293/356)	1.27 (0.86-1.87)

Supplementary Table 6: Coverage postnatal care (PNC) across background factors.

	PNC facility births		PNC all births	
	% (n/N)	OR (95%CI)	% (n/N)	OR (95%CI)
Overall	80 (1,128/1,412)		46 (1,232/2,678)	
Household assets				
0-2 items	67 (54/81)	Ref.	34 (57/168)	Ref.
3-4 items	79 (417/525)	2.08 (1.19-3.61)	44 (455/1,034)	1.61 (1.17-2.23)
5 items	82 (621/757)	2.38 (1.35-4.20)	49 (682/1,398)	1.97 (1.40-2.76)
Maternal education				
No schooling	82 (322/395)	Ref.	37 (352/957)	Ref.
Primary school	78 (333/428)	0.73 (0.53-1.02)	45 (369/818)	1.21 (1.00-1.45)
Secondary or higher	80 (456/567)	0.96 (0.68-1.35)	59 (492/841)	1.87 (1.55-2.25)
Parity				
Primigravida	79 (335/426)	Ref.	62 (345/557)	Ref.
1 prior birth	79 (209/263)	0.99 (0.66-1.48)	49 (234/477)	0.63 (0.48-0.82)
2-3 prior births	81 (286/351)	1.12 (0.78-1.61)	40 (328/827)	0.44 (0.34-0.56)
4+ prior births	80 (293/364)	1.08 (0.75-1.57)	40 (320/805)	0.47 (0.37-0.60)
Maternal age				
<20	75 (194/257)	Ref.	49 (203/411)	Ref.
20-24	80 (299/376)	1.27 (0.86-1.89)	46 (326/702)	0.89 (0.70-1.14)
25-29	80 (263/327)	1.27 (0.85-1.88)	44 (297/675)	0.74 (0.58-0.96)
30-34	81 (216/266)	1.34 (0.89-2.01)	46 (236/516)	0.81 (0.63-1.05)
35+	84 (137/164)	1.59 (0.96-2.63)	44 (151/340)	0.74 (0.56-0.97)
Region				
Oio	63 (114/180)	Ref.	25 (125/498)	Ref.
Biombo	78 (218/279)	2.06 (1.27-3.33)	57 (230/400)	3.32 (1.94-5.69)
Gabu	98 (172/175)	33.08 (10.82-101.10)	49 (183/376)	3.03 (1.63-5.64)
Cacheu	71 (175/246)	1.43 (0.92-2.22)	50 (219/437)	2.80 (1.71-4.60)
Bafatá	84 (133/158)	3.11 (1.71-5.67)	40 (137/343)	1.96 (1.04-3.70)
Quinara	85 (111/131)	3.21 (1.86-5.54)	53 (115/217)	3.17 (1.73-5.84)
Tombali	95 (125/132)	10.39 (4.68-23.11)	53 (137/257)	3.20 (1.81-5.66)
Bolama/Bubaque	83 (58/70)	2.80 (1.40-5.59)	82 (60/73)	11.68 (5.36-25.49)
Farim	54 (22/41)	0.67 (0.34-1.31)	34 (26/77)	1.56 (0.76-3.19)
Ethnicity				
Balanta	79 (280/354)	Ref.	38 (321/835)	Ref.
Fula/Mandinga	83 (422/509)	1.30 (0.79-2.14)	43 (451/1,058)	1.21 (0.83-1.77)
Manjaco/Mancanha	65 (57/88)	0.45 (0.26-0.78)	54 (65/121)	1.00 (0.63-1.61)
Pepel	77 (173/226)	0.73 (0.46-1.14)	56 (183/326)	1.15 (0.79-1.66)
Beafada	85 (76/89)	1.47 (0.74-2.90)	61 (78/127)	2.50 (1.33-4.70)
Bijagós	86 (32/37)	1.34 (0.56-3.21)	78 (36/46)	2.59 (1.26-5.31)
other	81 (80/99)	1.16 (0.59-2.31)	61 (90/148)	1.73 (1.08-2.79)

Distance to nearest health facility				
<2 km	80 (424/529)	Ref.	69 (460/667)	Ref.
2-5 km	81 (235/289)	1.12 (0.69-1.80)	46 (254/557)	0.37 (0.25-0.54)
5-8 km	78 (259/333)	0.96 (0.59-1.57)	37 (293/798)	0.31 (0.22-0.43)
>8 km	80 (210/261)	1.15 (0.69-1.91)	34 (225/656)	0.26 (0.18-0.38)

Potentially eligible children, n=4,126	**Exclusions, n=3,584** Pregnancy end not yet registered, n=13 Miscarriage, n=107 Moved before birth, n=53 Mother died during pregnancy, n=3 Card not inspected between 12 and 23 months of age, n= 3,408
Children eligible for analysis, n=542	

Supplementary Figure 1: Flowchart for the vaccination coverage assessments

Supplementary Table 7: Background factors of women interviewed on out-of-pocket payments for their last antenatal care consultation.

		n (%)	Missings/N (%)
	Total	1,197 (100)	0/1,197 (0)
Sociodemographic background factors	**Household assets**		68/1,197 (6)
	0-2 items	41 (4)	
	3-4 items	446 (40)	
	5 items	642 (57)	
	Maternal education		24/1,197 (2)
	No schooling	521 (44)	
	Primary school	356 (30)	
	Secondary or higher	296 (25)	
	Parity		144/1,197 (12)
	Primigravida	90 (9)	
	1 prior birth	183 (17)	
	2-3 prior births	401 (38)	
	4+ prior births	379 (36)	
	Maternal age		54/1,197 (5)
	<20	146 (13)	
	20-24	357 (31)	
	25-29	278 (24)	
	30-34	205 (18)	
	35+	157 (14)	
	Region		0/1,197 (0)
	Oio	251 (21)	
	Biombo	82 (7)	
	Gabu	157 (13)	
	Cacheu	106 (9)	
	Bafatá	196 (16)	
	Quinara	51 (4)	
	Tombali	56 (5)	
	Bafatá extra	220 (18)	
	Bolama/Bubaque	33 (3)	
	Farim	45 (4)	
	Ethnicity		2/1,197 (0)
	Balanta	242 (20)	
	Fula/Mandinga	757 (63)	
	Manjaco/Mancanha	26 (2)	
	Pepel	72 (6)	
	Beafada	42 (4)	
	Bijagós	9 (1)	
	other	47 (4)	
	Distance to nearest health facility		23/1,197 (2)

	<2 km	223 (19)	
	2-5 km	200 (17)	
	5-8 km	336 (29)	
	>8 km	415 (35)	
Antenatal care characteristics	**Consultation number**		54/1,197 (5)
	ANC1	416 (36)	
	ANC2	320 (28)	
	ANC3	210 (18)	
	ANC4+	197 (17)	
	Place of Care		0/1,197 (0)
	Health Centre (public)	1,013 (85)	
	Regional Hospital (public)	82 (7)	
	Outreach (public)	52 (4)	
	Health Centre (private/faith-based)	33 (3)	
	Care abroad	17 (1)	

Supplementary Table 8: Prevalence of out-of-pocket payments for antenatal care (ANC) at the point of care, by background factors.

		% (n/N)[1]
	Total	81 (966/1,195)
Sociodemographic background factors	**Household assets**	
	0-2 items	68 (28/41)
	3-4 items	83 (370/445)
	5 items	80 (510/641)
	Maternal education	
	No schooling	85 (440/520)
	Primary school	80 (285/355)
	Secondary or higher	75 (223/296)
	Parity	
	Primigravida	84 (76/90)
	1 prior birth	81 (147/182)
	2-3 prior births	79 (315/401)
	4+ prior births	82 (311/378)
	Maternal age	
	<20	88 (128/146)
	20-24	82 (291/356)
	25-29	77 (213/277)
	30-34	80 (165/205)
	35+	79 (124/157)
	Region	
	Oio	86 (215/250)
	Biombo	94 (77/82)
	Gabu	90 (141/156)
	Cacheu	67 (71/106)
	Bafatá	81 (158/196)
	Quinara	51 (26/51)
	Tombali	61 (34/56)
	Bafatá extra	87 (191/220)
	Bolama/Bubaque	39 (13/33)
	Farim	89 (40/45)
	Ethnicity	
	Balanta	78 (188/242)
	Fula/Mandinga	85 (640/755)
	Manjaco/Mancanha	58 (15/26)
	Pepel	90 (65/72)
	Beafada	55 (23/42)
	Bijagós	44 (4/9)
	other	64 (30/47)
	Distance to nearest health facility	

	<2 km	72 (160/223)
	2-5 km	88 (177/200)
	5-8 km	78 (261/335)
	>8 km	84 (346/414)
Antenatal care characteristics	**Consultation number**	
	ANC1	92 (382/416)
	ANC2	79 (252/319)
	ANC3	76 (160/210)
	ANC4+	66 (130/197)
	Place of Care	
	Health Centre (public)	82 (826/1,011)
	Regional Hospital (public)	72 (59/82)
	Outreach (public)	65 (34/52)
	Health Centre (private/faith-based)	94 (31/33)
	Care abroad	94 (16/17)

[1] Two observations with payments reported as "do not know" where omitted from this assessment.

Supplementary Table 9: Prevalence of any out-of-pocket payments for antenatal care (ANC) including transportation, by background factors.

		% (n/N)[1]
	Total	90 (1,073/1,197)
Sociodemographic background factors	**Household assets**	
	0-2 items	78 (32/41)
	3-4 items	90 (401/446)
	5 items	90 (576/642)
	Maternal education	
	No schooling	93 (482/521)
	Primary school	90 (321/356)
	Secondary or higher	84 (248/296)
	Parity	
	Primigravida	89 (80/90)
	1 prior birth	88 (161/183)
	2-3 prior births	89 (355/401)
	4+ prior births	92 (347/379)
	Maternal age	
	<20	92 (135/146)
	20-24	89 (319/357)
	25-29	88 (246/278)
	30-34	90 (184/205)
	35+	89 (140/157)
	Region	
	Oio	93 (234/251)
	Biombo	98 (80/82)
	Gabu	96 (150/157)
	Cacheu	83 (88/106)
	Bafatá	88 (173/196)
	Quinara	69 (35/51)
	Tombali	89 (50/56)
	Bafatá extra	93 (205/220)
	Bolama/Bubaque	42 (14/33)
	Farim	98 (44/45)
	Ethnicity	
	Balanta	89 (216/242)
	Fula/Mandinga	92 (696/757)
	Manjaco/Mancanha	73 (19/26)
	Pepel	96 (69/72)
	Beafada	69 (29/42)
	Bijagós	44 (4/9)
	other	83 (39/47)

Antenatal care characteristics	**Distance to nearest health facility**	
	<2 km	74 (164/223)
	2-5 km	94 (187/200)
	5-8 km	91 (306/336)
	>8 km	95 (394/415)
	Consultation number	
	ANC1	97 (402/416)
	ANC2	89 (284/320)
	ANC3	88 (185/210)
	ANC4+	78 (154/197)
	Place of Care	
	Health Centre (public)	90 (915/1,013)
	Regional Hospital (public)	93 (76/82)
	Outreach (public)	65 (34/52)
	Health Centre (private/faith-based)	97 (32/33)
	Care abroad	94 (16/17)

[1] Two women who did not know whether they had paid at the point of care both paid for transport.

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Supplementary Table 10: Background factors of women interviewed on out-of-pocket payments for their most recent birth.

		Overall		Facility births		Home births		Home births + PNC	
		n (%)	Missings/N (%)	n (%)	Missings/N (%)	n (%)	Missings/N (%)	n (%)	Missings/N (%)
	Total	1,441 (100)	0/1,441 (0)	803 (100)	0/803 (0)	577 (100)	0/577 (0)	61 (100)	0/61 (0)
Sociodemographic background factors	**Household assets**		45/1,441 (3)		24/803 (3)		19/577 (3)		2/61 (3)
	0-2 items	68 (5)		33 (4)		32 (6)		3 (5)	
	3-4 items	483 (35)		255 (33)		212 (38)		16 (27)	
	5 items	845 (61)		491 (63)		314 (56)		40 (68)	
	Maternal education		25/1,441 (2)		11/803 (1)		12/577 (2)		2/61 (3)
	No schooling	606 (43)		297 (38)		285 (50)		24 (41)	
	Primary school	469 (33)		245 (31)		204 (36)		20 (34)	
	Secondary or higher	341 (24)		250 (32)		76 (13)		15 (25)	
	Parity		11/1,441 (1)		6/803 (1)		4/577 (1)		1/61 (2)
	Primigravida	269 (19)		211 (26)		54 (9)		4 (7)	
	1 prior birth	229 (16)		128 (16)		91 (16)		10 (17)	
	2-3 prior births	460 (32)		230 (29)		210 (37)		20 (33)	
	4+ prior births	472 (33)		228 (29)		218 (38)		26 (43)	
	Maternal age		22/1,441 (2)		14/803 (2)		7/577 (1)		1/61 (2)
	<20	205 (14)		136 (17)		65 (11)		4 (7)	
	20-24	371 (26)		207 (26)		149 (26)		15 (25)	
	25-29	375 (26)		200 (25)		161 (28)		14 (23)	
	30-34	281 (20)		141 (18)		123 (22)		17 (28)	
	35+	187 (13)		105 (13)		72 (13)		10 (17)	
	Region		0/1,441 (0)		0/803 (0)		0/577 (0)		0/61 (0)
	Oio	173 (12)		67 (8)		101 (18)		5 (8)	
	Biombo	96 (7)		72 (9)		22 (4)		2 (3)	
	Gabu	121 (8)		79 (10)		38 (7)		4 (7)	
	Cacheu	192 (13)		120 (15)		47 (8)		25 (41)	
	Bafatá	275 (19)		147 (18)		120 (21)		8 (13)	
	Quinara	70 (5)		44 (5)		24 (4)		2 (3)	
	Tombali	105 (7)		63 (8)		37 (6)		5 (8)	
	Bafatá extra	340 (24)		160 (20)		172 (30)		8 (13)	

	Bolama/Bubaque	34 (2)	34 (4)	0 (0)	0 (0)
	Farim	35 (2)	17 (2)	16 (3)	2 (3)
	Ethnicity	2/1,441 (0)	2/803 (0)	0/577 (0)	0/61 (0)
	Balanta	318 (22)	149 (19)	151 (26)	18 (30)
	Fula/Mandinga	859 (60)	455 (57)	372 (64)	32 (52)
	Manjaco/Mancanha	54 (4)	45 (6)	7 (1)	2 (3)
	Pepel	84 (6)	64 (8)	19 (3)	1 (2)
	Beafada	45 (3)	34 (4)	10 (2)	1 (2)
	Bijagós	15 (1)	13 (2)	1 (0)	1 (2)
	other	64 (4)	41 (5)	17 (3)	6 (10)
	Distance to nearest health facility	19/1,441 (1)	8/803 (1)	11/577 (2)	0/61 (0)
	<2 km	284 (20)	245 (31)	19 (3)	20 (33)
	2-5 km	268 (19)	153 (19)	106 (19)	9 (15)
	5-8 km	432 (30)	195 (25)	214 (38)	23 (38)
	>8 km	438 (31)	202 (25)	227 (40)	9 (15)
Antenatal care obtained	**ANC1**	11/1,441 (1)	6/803 (1)	4/577 (1)	1/61 (2)
	yes	1,415 (99)	797 (100)	558 (97)	60 (100)
	no	15 (1)	0 (0)	15 (3)	0 (0)
	ANC4	70/1,441 (5)	47/803 (6)	18/577 (3)	5/61 (8)
	yes	842 (61)	543 (72)	257 (46)	42 (75)
	no	529 (39)	213 (28)	302 (54)	14 (25)
	ANC8	70/1,441 (5)	47/803 (6)	18/577 (3)	5/61 (8)
	yes	67 (5)	53 (7)	10 (2)	4 (7)
	no	1,304 (95)	703 (93)	549 (98)	52 (93)
Birth characteristics	**Birth outcome**	4/1,441 (0)	2/803 (0)	1/577 (0)	1/61 (2)
	Livebirth	1,388 (97)	765 (96)	566 (98)	57 (95)
	Stillbirth	37 (3)	26 (3)	9 (2)	2 (3)
	Livebirth & ENND	12 (1)	10 (1)	1 (0)	1 (2)
	Twin	17/1,441 (1)	11/803 (1)	5/577 (1)	1/61 (2)
	Yes	23 (2)	17 (2)	6 (1)	0 (0)
	No	1,401 (98)	775 (98)	566 (99)	60 (100)

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Supplementary Table 11: Background characteristics of facility births included in the out-of-pocket payment interviews for births.

	HF births	
	n (%)	Missings/N (%)
Total	803 (100)	0/803 (0)
Type of health facility		35/803 (4)
Health Centre (public)	438 (57)	
Regional Hospital (public)	220 (29)	
National Hospital (public)	47 (6)	
Health Centre (private/faith-based)	20 (3)	
Care abroad	43 (6)	
Type of birth		22/803 (3)
Vaginal birth without use of instruments	748 (96)	
Vaginal birth assisted with instruments	8 (1)	
Caesarean section	25 (3)	
Uterotonics		38/803 (5)
Yes	213 (28)	
No	552 (72)	

Supplementary Table 12: Prevalence of out-of-pocket payments for births at the point of care, by background factors.

		Overall[1] % (n/N)	Facility births[1] % (n/N)	Home births[1] % (n/N)	Home births + PNC % (n/N)
	Total	72 (1,038/1,434)	86 (688/797)	52 (299/576)	84 (51/61)
Sociodemographic background factors	**Household assets**				
	0-2 items	71 (48/68)	97 (32/33)	41 (13/32)	100 (3/3)
	3-4 items	70 (335/482)	85 (217/254)	50 (107/212)	69 (11/16)
	5 items	74 (620/839)	86 (417/486)	54 (168/313)	88 (35/40)
	Maternal education				
	No schooling	74 (445/604)	91 (268/296)	55 (156/284)	88 (21/24)
	Primary school	69 (320/466)	83 (201/242)	50 (103/204)	80 (16/20)
	Secondary or higher	75 (255/339)	84 (209/248)	43 (33/76)	87 (13/15)
	Parity				
	Primigravida	83 (220/265)	91 (188/207)	52 (28/54)	100 (4/4)
	1 prior birth	66 (152/229)	84 (107/128)	40 (36/91)	90 (9/10)
	2-3 prior births	66 (303/458)	83 (189/228)	47 (99/210)	75 (15/20)
	4+ prior births	75 (354/471)	87 (198/228)	62 (134/217)	85 (22/26)
	Maternal age				
	<20	76 (155/203)	93 (124/134)	43 (28/65)	75 (3/4)
	20-24	71 (261/368)	87 (178/204)	46 (69/149)	93 (14/15)
	25-29	71 (264/373)	84 (167/199)	52 (84/160)	93 (13/14)
	30-34	73 (205/281)	85 (120/141)	60 (74/123)	65 (11/17)
	35+	74 (138/187)	85 (89/105)	56 (40/72)	90 (9/10)
	Region				
	Oio	64 (111/173)	84 (56/67)	50 (50/101)	100 (5/5)
	Biombo	73 (69/95)	87 (62/71)	23 (5/22)	100 (2/2)
	Gabu	72 (86/120)	91 (71/78)	32 (12/38)	75 (3/4)
	Cacheu	82 (158/192)	87 (104/120)	70 (33/47)	84 (21/25)
	Bafatá	68 (186/274)	87 (127/146)	42 (51/120)	100 (8/8)
	Quinara	48 (33/69)	70 (30/43)	12 (3/24)	0 (0/2)
	Tombali	56 (59/105)	71 (45/63)	27 (10/37)	80 (4/5)
	Bafatá extra	87 (294/337)	98 (155/158)	77 (131/171)	100 (8/8)

	Bolama/Bubaque	68 (23/34)	68 (23/34)	. (0/0)	. (0/0)
	Farim	54 (19/35)	88 (15/17)	25 (4/16)	0 (0/2)
	Ethnicity				
	Balanta	63 (201/317)	80 (119/148)	44 (67/151)	83 (15/18)
	Fula/Mandinga	76 (651/854)	92 (413/451)	57 (210/371)	88 (28/32)
	Manjaco/Mancanha	83 (44/53)	86 (38/44)	71 (5/7)	50 (1/2)
	Pepel	75 (63/84)	88 (56/64)	32 (6/19)	100 (1/1)
	Beafada	56 (25/45)	71 (24/34)	10 (1/10)	0 (0/1)
	Bijagós	60 (9/15)	54 (7/13)	100 (1/1)	100 (1/1)
	other	67 (43/64)	71 (29/41)	53 (9/17)	83 (5/6)
	Distance to nearest health facility				
	<2 km	78 (218/281)	81 (195/242)	42 (8/19)	75 (15/20)
	2-5 km	75 (199/267)	89 (135/152)	53 (56/106)	89 (8/9)
	5-8 km	70 (301/431)	88 (171/194)	51 (109/214)	91 (21/23)
	>8 km	70 (307/436)	89 (179/201)	54 (121/226)	78 (7/9)
Antenatal care obtained	**ANC1**				
	yes	73 (1,022/1,408)	86 (682/791)	52 (290/557)	83 (50/60)
	no	60 (9/15)	. (0/0)	60 (9/15)	. (0/0)
	ANC4				
	yes	77 (643/838)	86 (466/540)	55 (141/256)	86 (36/42)
	no	66 (346/527)	87 (183/211)	50 (152/302)	79 (11/14)
	ANC8				
	yes	81 (54/67)	81 (43/53)	70 (7/10)	100 (4/4)
	no	72 (935/1,298)	87 (606/698)	52 (286/548)	83 (43/52)
Birth characteristics	**Birth outcome**				
	Livebirth	72 (997/1,381)	86 (653/759)	53 (297/565)	82 (47/57)
	Stillbirth	78 (29/37)	96 (25/26)	22 (2/9)	100 (2/2)
	Livebirth & ENND[2]	75 (9/12)	80 (8/10)	0 (0/1)	100 (1/1)
	Twin				
	Yes	87 (20/23)	88 (15/17)	83 (5/6)	. (0/0)
	No	72 (1,006/1,394)	86 (662/769)	52 (294/565)	83 (50/60)

[1] Overall, seven observations with payments reported as "do not know" where omitted from this assessment (Facility births: n=6; Home births: n=1).

[2] ENND: Early neonatal death, death within the firths 7 days of life.

Supplementary Table 13: Prevalence of out-of-pocket payments for births at the point of care, by background factors.

	% (n/N)
Total	86 (688/797)
Type of health facility	
Health Centre (public)	85 (371/435)
Regional Hospital (public)	85 (186/219)
National Hospital (public)	94 (44/47)
Health Centre (private/faith-based)	95 (19/20)
Care abroad	100 (43/43)
Type of birth	
Vaginal birth without use of instruments	86 (638/742)
Vaginal birth assisted with instruments	100 (8/8)
Caesarean section	84 (21/25)
Uterotonics	
Yes	92 (194/210)
No	84 (460/550)

Supplementary Table 14: Prevalence of any out-of-pocket payments for births including transportation, by background factors.

		Overall[1] % (n/N)	Facility births[1] % (n/N)	Home births % (n/N)	Home births + PNC[1] % (n/N)
	Total	77 (1,105/1,438)	94 (750/801)	52 (299/576)	92 (56/61)
Sociodemographic background factors	**Household assets**				
	0-2 items	71 (48/68)	97 (32/33)	41 (13/32)	100 (3/3)
	3-4 items	73 (353/483)	91 (233/255)	50 (107/212)	81 (13/16)
	5 items	79 (668/842)	94 (462/489)	54 (168/313)	95 (38/40)
	Maternal education				
	No schooling	77 (465/605)	97 (287/297)	55 (156/284)	92 (22/24)
	Primary school	74 (345/468)	92 (224/244)	50 (103/204)	90 (18/20)
	Secondary or higher	81 (276/340)	92 (228/249)	43 (33/76)	100 (15/15)
	Parity				
	Primigravida	86 (231/268)	95 (199/210)	52 (28/54)	100 (4/4)
	1 prior birth	72 (164/229)	92 (118/128)	40 (36/91)	100 (10/10)
	2-3 prior births	71 (328/459)	92 (211/229)	47 (99/210)	90 (18/20)
	4+ prior births	79 (373/471)	95 (216/228)	62 (134/217)	88 (23/26)
	Maternal age				
	<20	80 (165/205)	98 (133/136)	43 (28/65)	100 (4/4)
	20-24	74 (273/369)	93 (190/205)	46 (69/149)	93 (14/15)
	25-29	76 (284/374)	94 (187/200)	52 (84/160)	93 (13/14)
	30-34	77 (217/281)	91 (128/141)	60 (74/123)	88 (15/17)
	35+	79 (148/187)	94 (99/105)	56 (40/72)	90 (9/10)
	Region				
	Oio	68 (118/173)	94 (63/67)	50 (50/101)	100 (5/5)
	Biombo	77 (74/96)	93 (67/72)	23 (5/22)	100 (2/2)
	Gabu	75 (90/120)	96 (75/78)	32 (12/38)	75 (3/4)
	Cacheu	87 (167/192)	92 (111/120)	70 (33/47)	92 (23/25)
	Bafatá	73 (200/275)	96 (141/147)	42 (51/120)	100 (8/8)
	Quinara	57 (39/69)	81 (35/43)	12 (3/24)	50 (1/2)
	Tombali	69 (72/105)	90 (57/63)	27 (10/37)	100 (5/5)
	Bafatá extra	88 (299/339)	100 (160/160)	77 (131/171)	100 (8/8)

	Bolama/Bubaque	71 (24/34)	71 (24/34)	. (0/0)	. (0/0)
	Farim	63 (22/35)	100 (17/17)	25 (4/16)	50 (1/2)
	Ethnicity				
	Balanta	67 (214/318)	88 (131/149)	44 (67/151)	89 (16/18)
	Fula/Mandinga	79 (681/857)	97 (442/454)	57 (210/371)	91 (29/32)
	Manjaco/Mancanha	92 (49/53)	95 (42/44)	71 (5/7)	100 (2/2)
	Pepel	79 (66/84)	92 (59/64)	32 (6/19)	100 (1/1)
	Beafada	76 (34/45)	94 (32/34)	10 (1/10)	100 (1/1)
	Bijagós	60 (9/15)	54 (7/13)	100 (1/1)	100 (1/1)
	other	78 (50/64)	85 (35/41)	53 (9/17)	100 (6/6)
	Distance to nearest health facility				
	<2 km	83 (234/282)	86 (209/243)	42 (8/19)	85 (17/20)
	2-5 km	80 (214/268)	97 (149/153)	53 (56/106)	100 (9/9)
	5-8 km	74 (321/432)	97 (189/195)	51 (109/214)	100 (23/23)
	>8 km	74 (323/437)	97 (195/202)	54 (121/226)	78 (7/9)
Antenatal care obtained	**ANC1**				
	yes	77 (1,089/1,412)	94 (744/795)	52 (290/557)	92 (55/60)
	no	60 (9/15)	. (0/0)	60 (9/15)	. (0/0)
	ANC4				
	yes	82 (686/841)	93 (506/543)	55 (141/256)	93 (39/42)
	no	69 (366/528)	95 (202/212)	50 (152/302)	86 (12/14)
	ANC8				
	yes	88 (59/67)	91 (48/53)	70 (7/10)	100 (4/4)
	no	76 (993/1,302)	94 (660/702)	52 (286/548)	90 (47/52)
Birth characteristics	**Birth outcome**				
	Livebirth	77 (1,062/1,385)	93 (713/763)	53 (297/565)	91 (52/57)
	Stillbirth	81 (30/37)	100 (26/26)	22 (2/9)	100 (2/2)
	Livebirth & ENND[2]	83 (10/12)	90 (9/10)	0 (0/1)	100 (1/1)
	Twin				
	Yes	91 (21/23)	94 (16/17)	83 (5/6)	. (0/0)
	No	77 (1,072/1,398)	94 (723/773)	52 (294/565)	92 (55/60)

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[1] Overall, three observations with payments reported as "do not know" where omitted from this assessment (Facility births: n=2; Home births: n=1). Of the six women with facility births who did not know whether they had paid at the point of care four paid for transport.
[2] ENND: Early neonatal death, death within the firths 7 days of life.

Supplementary Table 15: Prevalence of any out-of-pocket payments for births including transportation, by background factors.

	% (n/N)
Total	94 (750/801)
Type of health facility	
Health Centre (public)	93 (406/437)
Regional Hospital (public)	95 (208/220)
National Hospital (public)	98 (46/47)
Health Centre (private/faith-based)	95 (19/20)
Care abroad	100 (43/43)
Type of birth	
Vaginal birth without use of instruments	94 (699/746)
Vaginal birth assisted with instruments	100 (8/8)
Caesarean section	88 (22/25)
Uterotonics	
Yes	98 (209/213)
No	92 (504/550)

Supplementary Table 16: Multilevel models to investigate factors decisive for ANC4 coverage.

Uptake of four or more ANC visits uOR (80% CI)	Model I (n=3417)	Model II (n=3352) aOR (95% CI)	Model III (n=3162) aOR (95% CI)	Model IV (n=3162) aOR (95% CI)
Health area level (29 clusters)				
Provision of ANC consultations (number of days/week)				
5	1	1		1
7	0.51 (0.29-0.89)	0.53 (0.23-1.22)		0.56 (0.25-1.25)
Quality of health facility infrastructure				
Reasonable	1	1		1
Good	1.17 (0.84-1.62)	1.17 (0.70-1.96)		1.10 (0.68-1.79)
Bad	0.24 (0.10-0.57)	0.19 (0.05-0.68)		0.29 (0.08-1.05)
Village level (180 clusters)				
Distance to the nearest health centre				
<2km	1	1		1
>=2 to 5km	0.56 (0.40-0.80)	0.56 (0.33-0.95)		0.64 (0.37-1.10)
>=5 to 8km	0.62 (0.44-0.88)	0.59 (0.34-1.00)		0.72 (0.41-1.27)
>=8km	0.49 (0.35-0.68)	0.46 (0.28-0.76)		0.54 (0.32-0.93)
Family group level (1588 clusters)				
Birth order				
1st	1		1	1
2nd or 3rd	0.68 (0.58-0.79)		0.99 (0.56-1.75)	0.99 (0.56-1.76)
4th or 5th	0.62 (0.52-0.72)		0.81 (0.41-1.58)	0.82 (0.42-1.60)
>=6th	0.51 (0.43-0.61)		0.70 (0.34-1.44)	0.73 (0.35-1.50)
Number of household assets				
0-2	1		1	1
3	1.07 (0.83-1.38)		1.17 (0.79-1.74)	1.15 (0.77-1.70)
4	1.42 (1.13-1.79)		1.49 (1.04-2.15)	1.44 (1.00-2.08)
5	1.65 (1.31-2.09)		1.76 (1.22-2.56)	1.71 (1.18-2.48)
Education (years)				

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No formal education	1	1	1
>=1 to 4	1.23 (1.07-1.42)	1.11 (0.88-1.41)	1.13 (0.89-1.43)
>=4 to 6	1.55 (1.33-1.82)	1.39 (1.07-1.79)	1.38 (1.07-1.79)
>=6	1.72 (1.43-2.06)	1.45 (1.06-1.97)	1.42 (1.04-1.94)
Ethnicity			
Fula	1	1	1
Mandinga	0.86 (0.68-1.10)	0.89 (0.61-1.30)	0.86 (0.59-1.26)
Balanta	0.60 (0.43-0.83)	0.58 (0.35-0.97)	0.66 (0.39-1.10)
Pepel	1.40 (0.97-2.02)	1.52 (0.84-2.74)	1.16 (0.62-2.15)
Manjaco/Mancanha	1.68 (0.87-3.23)	1.14 (0.40-3.27)	1.16 (0.41-3.31)
Other/Multi-ethnic	0.76 (0.49-1.17)	0.65 (0.33-1.29)	0.62 (0.31-1.24)
Household size			
Primigravida	1	1	1
>=1 to 3 children	0.63 (0.55-0.73)	0.65 (0.37-1.13)	0.63 (0.36-1.11)
>=3 to 6 children	0.61 (0.53-0.71)	0.86 (0.44-1.66)	0.86 (0.44-1.67)
>=6 children	0.46 (0.36-0.59)	0.76 (0.35-1.64)	0.74 (0.34-1.61)

Supplementary Table 17: Multilevel models to investigate factors decisive for Facility birth coverage.

	uOR (80% CI)	Model I (n=3678) Model II (n=3619) aOR (95% CI)	Model III (n=3335) aOR (95% CI)	Model IV (n=3282) aOR (95% CI)
Health area level (27 clusters)				
Quality of health facility infrastructure				
Reasonable	1	1		1
Good	0.92 (0.66-1.29)	0.86 (0.58-1.28)		0.89 (0.62-1.29)
Bad	0.29 (0.13-0.64)	0.16 (0.06-0.39)		0.22 (0.08-0.57)
Availability of evacuation vehicles				
No	1	1		1
Yes, ambulance	1.86 (1.38-2.51)	0.94 (0.61-1.45)		0.88 (0.58-1.34)
Yes motorcycle	0.30 (0.16-0.55)	0.22 (0.10-0.51)		0.28 (0.12-0.64)
Availability of exclusive pre-/postpartum room				
Yes	1	1		1
No	0.56 (0.35-0.91)	1.04 (0.62-1.72)		0.95 (0.61-1.47)
Village level (145 clusters)				
Distance to nearest health centre				
<2km	1			1
>=2 to 5km	0.44 (0.29-0.65)	0.48 (0.27-0.87)		0.51 (0.29-0.90)
>=5 to 8km	0.34 (0.23-0.51)	0.36 (0.20-0.65)		0.42 (0.23-0.77)
>=8km	0.22 (0.15-0.33)	0.22 (0.12-0.39)		0.26 (0.14-0.48)
Family group level (1479 clusters)				
Birth order				
1st	1		1	1
2nd or 3rd	0.25 (0.21-0.29)		0.89 (0.62-1.29)	0.22 (0.12-0.39)
4th or 5th	0.20 (0.17-0.24)		0.15 (0.07-0.30)	0.16 (0.08-0.32)
>=6th	0.27 (0.22-0.32)		0.18 (0.09-0.39)	0.20 (0.10-0.43)
Season of the year (at birth)				
Dry season	1		1	1
Rainy season	1.37 (1.23-1.53)		1.34 (1.11-1.61)	1.35 (1.12-1.62)
Number of household assets				
0-2	1		1	1
3	0.94 (0.76-1.18)		0.91 (0.63-1.31)	0.88 (0.61-1.26)
4	1.15 (0.93-1.41)		1.22 (0.86-1.71)	1.18 (0.84-1.66)
5	1.36 (1.10-1.68)		1.40 (0.98-1.98)	1.35 (0.95-1.91)
Education (years)				
No formal education	1		1	1
>=1 to 4	1.07 (0.93,1.23)		0.87 (0.68,1.10)	0.88 (0.69,1.12)

>=4 to 6	1.32 (1.13,1.53)	1.03 (0.79,1.34)	1.01 (0.78,1.31)
>=6	1.73 (1.43,2.08)	1.36 (0.99,1.87)	1.34 (0.97,1.85)
Age (years)			
< 19	1	1	1
>=19 to 25	0.44 (0.37-0.53)	1.10 (0.78-1.55)	1.07 (0.76-1.51)
>=25 to 35	0.40 (0.34-0.47)	1.83 (1.21-2.77)	1.81 (1.20-2.74)
>=35	0.37 (0.30-0.46)	1.88 (1.12-3.14)	1.88 (1.12-3.14)
Ethnicity			
Fula	1	1	1
Mandinga	1.11 (0.85-1.44)	1.05 (0.71-1.57)	1.00 (0.68-1.48)
Balanta	0.71 (0.52-0.95)	0.54 (0.34-0.86)	0.72 (0.42-1.24)
Pepel	2.48 (1.79-3.43)	2.17 (1.31-3.60)	1.20 (0.69-2.08)
Manjaco/Mancanha	2.38 (1.06-5.35)	1.03 (0.27-3.85)	1.18 (0.32-4.30)
Other/Multi-ethnic	1.78 (1.11-2.84)	1.47 (0.69-3.14)	1.30 (0.61-2.79)
Household size			
Primigravida	1	1	1
>=1 to 3 children	0.28 (0.24-0.33)	0.61 (0.36-1.02)	0.60 (0.35-1.00)
>=3 to 6 children	0.26 (0.22-0.30)	0.50 (0.27-0.93)	0.46 (0.25-0.87)
>=6 children	0.33 (0.26-0.42)	0.56 (0.27-1.16)	0.50 (0.24-1.05)
Mother attended at least 1 ANC consultation			
Yes	1	1	1
No/Doesn't know	0.73 (0.57-0.93)	0.77 (0.51-1.16)	0.75 (0.50-1.13)
Previous facility delivery			
Yes	1	1	1
Unknown	0.67 (0.59-0.75)	0.55 (0.45-0.67)	0.55 (0.45-0.67)
No/Primigravida	1.29 (1.12-1.50)	0.36 (0.26-0.50)	0.38 (0.28-0.53)

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