



**Estimates of Maternal Mortality and Stillbirths and
Causes of Maternal Mortality in Lagos State
Findings from the Lagos State Verbal and Social Autopsy
Sample Registration System**

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**African Population and
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Abbreviations

APHRC	African Population and Health Research Center
CCTRIS	Centre for Clinical Trials, Research and Implementation Science
CMUL	College of Medicine, University of Lagos
CRVS	Civil Registration and Vital Statistics
NDHS	Demographic Health Survey
EAs	Enumeration Areas
LASUCOM	Lagos State University College of Medicine
LBS	Lagos Bureau of Statistics
LSMOH	Lagos State Ministry of Health
LSPHCB	Lagos State Primary Health Care Board
LVASA-SRS	Lagos State Verbal and Social Autopsy - Sample Registration System
MICS	Multiple Indicator Cluster Surveys
MNCH	Maternal, Newborn and Child Health
MPDSR	Maternal and Perinatal Death Surveillance and Response
NBS	National Bureau of Statistics
NPoPC	National Population Commission
SA	Social Autopsy
VA	Verbal Autopsy

Executive Summary

The Lagos State Verbal and Social Autopsy - Sample Registration System (LVASA-SRS) is a Gates Foundation-funded initiative implemented by a consortium led by the Centre for Clinical Trials, Research and Implementation Science (CCTRIS). The project involved household mapping and listing a total of 127,039 households across 1,911 enumeration areas (EAs), identification of 5,020 pregnant women, 7,217 live births, 61 maternal deaths, and 291 stillbirths that occurred between March 2023 (one year before commencement) and February 2025, and conduct of Verbal Autopsy (VA) and Social Autopsy (SA) interviews for identified maternal deaths. The project generated reliable and updated estimates of maternal deaths and stillbirths, understood their clinical causes and social determinants, and further aims to strengthen the Maternal and Perinatal Death Surveillance and (MPDSR) system in Lagos State.

The analysis yielded a statewide MMR estimate of 833 per 100,000 live births with significant LGA variation (Range: From 154 in Somolu to 4,211 in Badagry) and an SBR estimate of 38.1 per 1,000 total births, with significant LGA variation (Range: From 7.4 in Lagos Island to 120.6 in Alimosho).

For the maternal deaths, the VA established that the leading causes of maternal mortality, were haemorrhage, hypertensive disorders, unsafe abortion, ruptured uterus, and sepsis. Based on the 59 SA interviews conducted across all LGAs, it was clear that there are structural delays in care seeking and facility response in Lagos State.

Based on LVASA-SRS evidence, the government should:

1. Prioritise the problem of maternal and perinatal mortality with emphasis placed on LGAs with highest MMR and SBR.
2. Initiate and sustain multi-pronged and targeted approaches to address the observed social determinants of health across the different delay phases and LGAs in Lagos.
3. Formally integrate key SRS components (VA/SA, community focal persons, digital dashboards) into MPDSR guidelines and tools.
4. Ensure provisions for community-level reporting, confidentiality, and non-punitive learning as part of a routine state-level cMPDSR that reports LGA-level MMR and SBR estimates as well as obstetric and social cause of maternal deaths in Lagos State.
5. Use social autopsy evidence to guide where and how to intervene in maternal and perinatal mortality reduction efforts.

1 Background and Rationale

1.1 The Data Gap in Maternal and Perinatal Mortality

Despite substantial investments in maternal and newborn health, Lagos State and Nigeria continue to face challenges in accurately measuring maternal mortality and stillbirths. While facility-based MPDSR has improved documentation of deaths within health facilities, many maternal and perinatal deaths still occur at home, in transit, or in private facilities, where reporting is either inconsistent or absent. As a result, routine facility data alone cannot provide a comprehensive assessment of the true mortality burden.

The national Civil Registration and Vital Statistics (CRVS) system, despite its legal mandate for compulsory registration of all deaths within 30 days, remains underutilised; registering only about 10% of deaths and almost no stillbirths are registered. Data from population-based surveys, such as demographic health survey (DHS), Multiple Indicator Cluster Surveys (MICS), and censuses, have been used over the years to inform policy making and interventional programs. However, these surveys have several limitations that make their data less accurate and reliable for timely and effective interventions. These include the use of indirect estimation methods, which are prone to undercounting, infrequent surveys, making it difficult to monitor trends or detect emerging patterns and the fact that their results are frequently outdated by the time they are released after fieldwork, reducing their relevance for timely intervention and planning. Similarly, they provide limited detail on medical causes of death and almost no insight into social, cultural, or health system drivers of mortality. They also lack granular LGA-level disaggregation, which is essential for targeted interventions.¹

Lagos State is a megacity of over 24.6 million inhabitants in 2015, with one of the highest annual number of births in Nigeria,² needs timely and actionable data for effective programmatic interventions to reduce preventable pregnancy-related deaths. The absence of this reliable, real-time data limits the government's ability to determine the true magnitude and distribution of maternal mortality and stillbirths; understand drivers of preventable deaths, including delays and sociocultural practices; allocate resources efficiently and implement targeted, high-impact interventions; monitor progress toward SDG 3.1 and state MNCH priorities; and strengthen accountability within the MPDSR system.

¹ Maduekwe, N.I., O.O. Banjo, and M.O. Sangodapo, The Nigerian Civil Registration and Vital Statistics System Contexts, Institutions, Operation. *Social Indicators Research*, 2017. 134(2): p. 651-674.

² Lagos State Government. About Lagos. 2023 [cited 2023 May 16, 2023]; Available from: <https://lagosstate.gov.ng/about-lagos/>

In 2012, the Lagos State Ministry of Health funded a team of researchers to estimate the state's MMR. Using the less precise indirect sisterhood method, they reported an MMR of 555 per 100,000 live births and substantial variation in mortality across local government areas (LGAs) (e.g., MMR ranging from 310 to 826 per 100,000 live births) in Lagos Island and Alimosho LGAs, respectively.³ A more recent study using the same indirect sisterhood method reported a statewide MMR estimate of 430 without LGA -based estimates.⁴ The less precise method used, in addition to the small sample size, of these estimates, limit their robustness. Further, the estimates are now outdated, and the most recent effort did not generate LGA level estimates, which are particularly useful to inform policy and service planning in Lagos. The state requires a continuous, representative, and technically robust surveillance mechanism going forward.

1.2 Why a Sample Registration System (SRS)?

A Sample Registration System (SRS) provides a structured method to generate direct, population-level estimates of mortality and causes of death through continuous or periodic surveillance of a representative sample of households. SRS models have been successfully implemented in countries such as Mozambique and Sierra Leone to address limitations of weak CRVS systems.^{5,6} The SRS approach offers several advantages essential for Lagos State, such as direct counting of deaths, including those occurring outside health facilities, integration of Verbal and Social Autopsy (VA/SA) to determine medical and social causes of death, and timely, routine data generation that supports monitoring of trends and intervention performance. Others include the ability to produce LGA-disaggregated estimates, informing targeted resource allocation, and a platform that complements and strengthens CRVS and MPDSR, rather than replacing them.

LVASA-SRS was therefore conceptualised as a prototype maternal and perinatal mortality SRS for Lagos State, with the intention that core components such as structured surveillance, VA/SA, community follow-up can later be embedded into MPDSR and CRVS. The project provides Lagos State with the first opportunity to generate real-time, state-representative mortality data that directly links medical causes with contextual social determinants, enabling more responsive public health action.⁷

³ Lagos State Ministry of Health, Reducing Health Disparities in Lagos State: An Investment Case. 2012: Lagos State Ministry of Health.

⁴ Wright KO, Fagbemi T, Omoera V, et al. A population-based estimation of maternal mortality in Lagos State, Nigeria using the indirect sisterhood method. *BMC Pregnancy Childbirth*. 2024;24(1):314.

⁵ Macicame, I., et al., Countrywide Mortality Surveillance for Action in Mozambique: Results from a National Sample-Based Vital Statistics System for Mortality and Cause of Death. *Am J Trop Med Hyg*, 2023. 108(5_Suppl): p. 5-16.

⁶ Carshon-Marsh, R., et al., Child, maternal, and adult mortality in Sierra Leone: nationally representative mortality survey 2018-20. *Lancet Glob Health*, 2022. 10(1): p. e114-e123.

⁷ Setel, P.W., et al., Sample registration of vital events with verbal autopsy: a renewed commitment to measuring and monitoring vital statistics. *Bull World Health Organ*, 2005. 83(8): p. 611-7.

1.3 Alignment with Lagos State priorities

The LVASA-SRS is strongly aligned with the Lagos State Government’s commitment to reducing maternal and perinatal mortality, as outlined in the State Maternal, Newborn and Child Health (MNCH) Strategy 2020–2025, Maternal and Child Mortality Reduction Programme, and in the ongoing efforts to strengthen community-based MPDSR. Specifically, LVASA-SRS supports these Lagos State priorities by:

1. Providing the first direct, LGA-disaggregated estimates of MMR and SBR across all 20 LGAs.
2. Identifying both clinical causes and contextual drivers.
3. Strengthening the community-based MPDSR, which is essential for capturing deaths occurring outside facilities.
4. Building state capacity to implement continuous mortality surveillance, use digital tools, and translate evidence into interventions.
5. Providing a foundation for digital dashboards and real-time decision support systems.
6. Creating a pathway for eventual integration of SRS with MPDSR and CRVS, enabling Lagos State to institutionalise a sustainable, government-led mortality surveillance system.

2 Project objectives

2.1 Primary objectives

The primary objectives of the project were first to establish a functioning state-wide Sample Registration System (SRS) that can be sustainably used for monitoring maternal mortality and stillbirths in Lagos State during and beyond the life cycle of the study. The second primary objective was to retrospectively estimate the annual Maternal Mortality Ratio (MMR) and Stillbirth Rate (SBR) in Lagos State for the one year before March 2024 (retrospective).

2.2 Secondary objectives

1. To identify the medical causes of maternal deaths and the social, cultural, and health system factors that contribute to them in Lagos state.
2. To understand care-seeking pathways, cultural practices, and social support for women who died or experienced stillbirths, including positive deviants.
3. To recommend evidence-informed interventions and policy actions to reduce preventable maternal deaths and stillbirths.

3 Study design and Implementation approach

3.1 Study design

The LVASA-SRS adopted a descriptive cross-sectional household survey design implemented through a mixed-methods approach, integrating quantitative enumeration with qualitative inquiry to generate a comprehensive picture of maternal and perinatal mortality in Lagos State. The design was implemented in two sequential phases: retrospective (March 2023 – February 2025) and prospective phase (March 2024 – June 2025). The report focuses on the retrospective phase

The retrospective phase involved systematic mapping and listing of sampled Enumeration Areas (EAs), identification of maternal deaths, stillbirths, live births, and currently pregnant women over the preceding year. Verbal Autopsy (VA) and Social Autopsy (SA) interviews were conducted to determine medical causes of death and explore the sociocultural and health system factors contributing to mortality. This phase provided baseline mortality estimates and contextual information to inform the prospective phase.

3.2 Sampling, mapping, and enumeration

A total of 2,040 Enumeration Areas (EAs) across all 20 LGAs were selected using sampling frames provided by the National Population Commission (NPopC) and a DHS-consistent two-stage cluster sampling design, ensuring representation across urban, peri-urban, and rural settings (Table 1). Field operations commenced with the mapping and listing of households. Below is a summary of data captured as of 30th June 2025.

Table 1: Summary data of households and enumeration area coverage

Data Item	Value
Total buildings	24,450
Total validated buildings in EA	24,249
Total residential	23,298
Total non-residential	951
Total number of EAs (Paper Maps)	415
Total EAs completed (Paper Maps)	415
Total number of EAs (Digital Maps)	1,625
Total EAs completed (Digital Maps)	1,496
Total number of EAs	2,040
Total number of EAs completed (Paper + Digital Maps)	1,911
Total number of households	127,039

Mapping and listing process: The project implemented a staged, technically rigorous mapping and listing exercise to identify households and persons of interest. 415 EAs were initially mapped using paper maps, consistent with NPC legacy mapping structures, followed by another 1,625 EAs using GPS-enabled digital maps, improving spatial accuracy in dense urban landscapes,

informal settlements, and areas with poorly defined boundaries. A total of 127,039 households were mapped and listed across 1,911 fully completed EAs by June 2025 [Table 1].

Identification of key respondents and events: Data collectors conducted door-to-door visits to identify pregnant women, live births, stillbirths, and maternal deaths occurring during the reference period. A full household sweep was conducted within each EA to ensure complete identification of all events. As field realities evolved, the team adopted a refined operational strategy of revisiting 50 households per EA for more efficient and cost-effective enumeration while maintaining representativeness.

3.3 Data collection

The LVASA-SRS relied on a suite of validated, interoperable tools to ensure scientific rigour, digital efficiency, and adaptability for long-term government use. These tools were the 2022 WHO verbal autopsy and the Johns Hopkins University's Institute for International Programs (JHU/IIP) social autopsy tool. The 2022 WHO verbal autopsy tool was adapted for the Lagos context to reflect cultural and language appropriateness, including translation into broken English and Yoruba with back-translation for linguistic fidelity. This was used to collect information on the biological causes of death. JHU/IIP Social Autopsy tool was used to capture context-specific information on care-seeking, cultural practices, delays, and household decision-making to determine the social determinants of maternal deaths.

KoboToolbox (Harvard Humanitarian Initiative, Cambridge, MA, USA) was the primary electronic data capture platform used for data collection. Trained data collectors were tasked to conduct the mapping and enumeration of households, and the VA and SA interviews. An initial 88 data collectors trained and re-trained (Aug–Sept 2024) on mapping, listing, VA administration, and digital mapping tools. An additional 68 data collectors were recruited and trained between January and February 2025 to accommodate expanded enumeration and VA/SA workload. Another 16 data collectors received advanced training in SA methodology, ethics, grief management, and narrative documentation in March 2025. Separately, 54 CHPs were trained in June 2025 on digital map navigation, pregnancy tracking, real-time documentation, conducting follow-up visits, and on their role as trusted, locally embedded surveillance agents, essential for sustainable community-based MPDSR.

The trained data collectors conducted sensitive, standardised interviews to document symptoms, care-seeking patterns, and circumstances preceding death. The cause-of-death assignment followed a hybrid approach using InterVA-5 for initial probabilistic coding, and physician review for cases with <70% algorithmic certainty or incongruent narratives.

For the SA, respondents included spouses, caregivers, and neighbours with direct knowledge of events. Between 14 March and 10 May 2025, the project conducted 59 Social Autopsy interviews across all 20 LGAs. All interviews involved maternal deaths that had previously undergone VA, enabling a unique triangulation of clinical and socio-behavioural determinants. The narratives illuminated the behavioural and contextual factors behind clinical outcomes, enabling identification of modifiable barriers across communities and facilities. The SA findings elucidated the social, cultural, economic, and health system factors contributing to the deaths, strengthening the interpretation of VA findings and highlighting modifiable behavioural and system-level barriers.

Supervisors implemented a multi-layered quality control system during data collection. This included real-time WhatsApp support groups for troubleshooting, daily field debrief meetings, Excel-based dashboards to monitor data completeness, timeliness, geolocation accuracy, and interviewer performance, validation checks embedded in KoboToolbox, and fee-for-service reimbursement linked to quality metrics.

Given the sensitive nature of maternal and perinatal death investigations, LVASA-SRS deliberately implemented a human-centred engagement model, which became instrumental in achieving community acceptance and cooperation. Empathy packages and grief-support referral cards were provided to bereaved families, acknowledging their loss and facilitating willingness to participate in VA and SA interviews. Psychosocial support for data collectors was institutionalised, recognising the emotional burden associated with repeated exposure to traumatic narratives. Delivery kits were given to pregnant women encountered during fieldwork to reinforced goodwill and strengthened trust between field teams and communities. While engagement practices emphasised respect, confidentiality, and cultural sensitivity, which significantly improved rapport and reduced refusal rates.

3.4 Data analysis and visualisation

Data were cleaned and analysed in R v.4.3.2 (R Development Core Team, Auckland, New Zealand). Descriptive statistics were summarised as frequencies, proportions, and means with standard deviations. InterVA-5 algorithm-based model and physician review were used to establish cause of death. The InterVA-5 method processed 20 cases, while physicians independently reviewed 8 VA interviews. The two methods showed approximately 50% concordance, a level consistent with global literature and indicative of their differential strengths. InterVA-5 delivered consistent and scalable outputs, unaffected by fatigue or subjective variation, making it particularly suitable for large community-based mortality datasets. Conversely, physician review offered the interpretation of complex clinical presentations, integrating contextual cues from VA narratives that automated models may not capture. Based on the assessment, LVASA-SRS adopted a hybrid cause-of-death coding model, consisting of primary coding using InterVA-5 for all maternal deaths and physician review for cases with algorithmic certainty below 70% or where VA narratives suggested complex or multifactorial conditions. This model ensured a balance of methodological robustness, scalability, and contextual accuracy, providing Lagos State with the most reliable foundation for intervention planning and future institutionalisation within MPDSR workflows.

For the SA, analysis was closely aligned with the Three Delays model, providing a structured framework for understanding the pathways that culminate in preventable deaths.

Overall, the dataset generated provided a holistic overview of maternal and perinatal mortality, enabling identification of epidemiological patterns, systemic bottlenecks, and socio-cultural determinants. The emerging evidence serves as a baseline estimate for MMR and SBR as well as evidence on obstetric causes and social determinants of deaths.

The LVASA-SRS team developed a fully functional, interactive digital dashboard developed in Looker Studio, representing a major milestone in the transition toward real-time surveillance. Key features of the interactive digital dashboard included real-time visualisation of MMR, SBR, EA and household coverage, and geospatial mapping that displays the distribution of maternal deaths, stillbirths, and live births across LGAs and EAs. The automated updates via direct linkage to KoboToolbox-generated CSVs will ensure that policymakers access the most current data, while the user-friendly interface will enable LGA and state-level health managers to easily interpret trends, monitor surveillance completeness, and identify mortality hotspots rapidly.

4 Findings

4.1 MMR and SBR estimates

During household visitation across the 12-month reference period, data collectors identified 5,020 pregnant women, 7,217 live births, 61 maternal deaths, and 291 stillbirths.

The analysis yielded a statewide MMR estimate of 833 per 100,000 live births and an SBR estimate of 38.1 per 1,000 total births.

Substantial variation was observed across LGAs, with Somolu having the lowest MMR: Somolu (154 per 100,000 livebirths) and Badagry having the highest MMR (4,210 per 100,000 livebirths). LGAs including Amuwo Odofin, Ifako-Ijaiye, Lagos Island, Ikorodu, and Mushin also recorded MMRs above the state average (Figure 1).

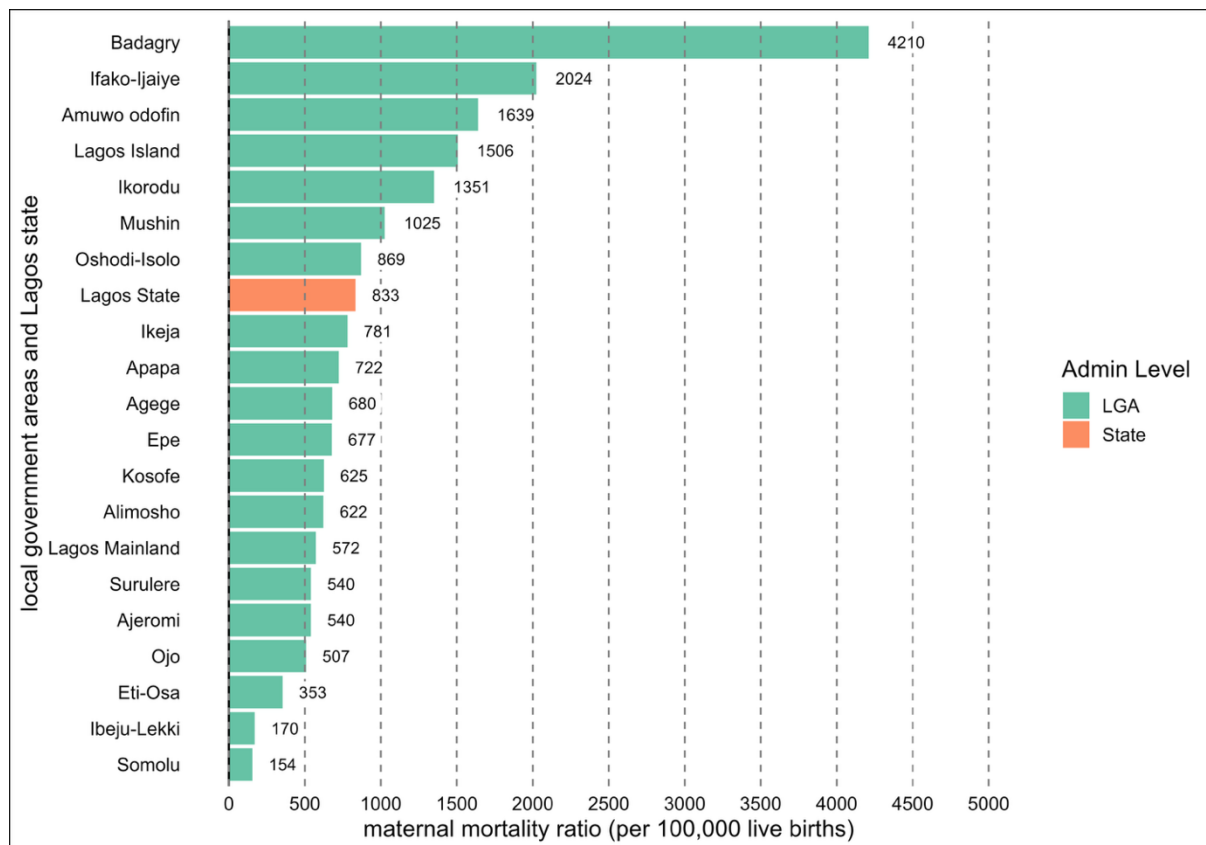


Figure 1: MMR estimates across the 20 local government areas and the state

SBR varied considerably across LGAs, with Alimosho recording the highest rate at 120.6 per 1,000 (95%CI: 119.9 – 121.4), followed by Shomolu (95.2; 95%CI: 94.6–97.1), Ikorodu (46.8; 95%CI:

46.0–47.7) and Eti-Osa (43.5; 95%CI: 42.8 – 44.2). Lower SBRs were also observed in Lagos Island (7.4; 95%CI: 7.1–7.6) and Ikeja (11.5; 95%CI: 11.1–11.9) (Figure 2).

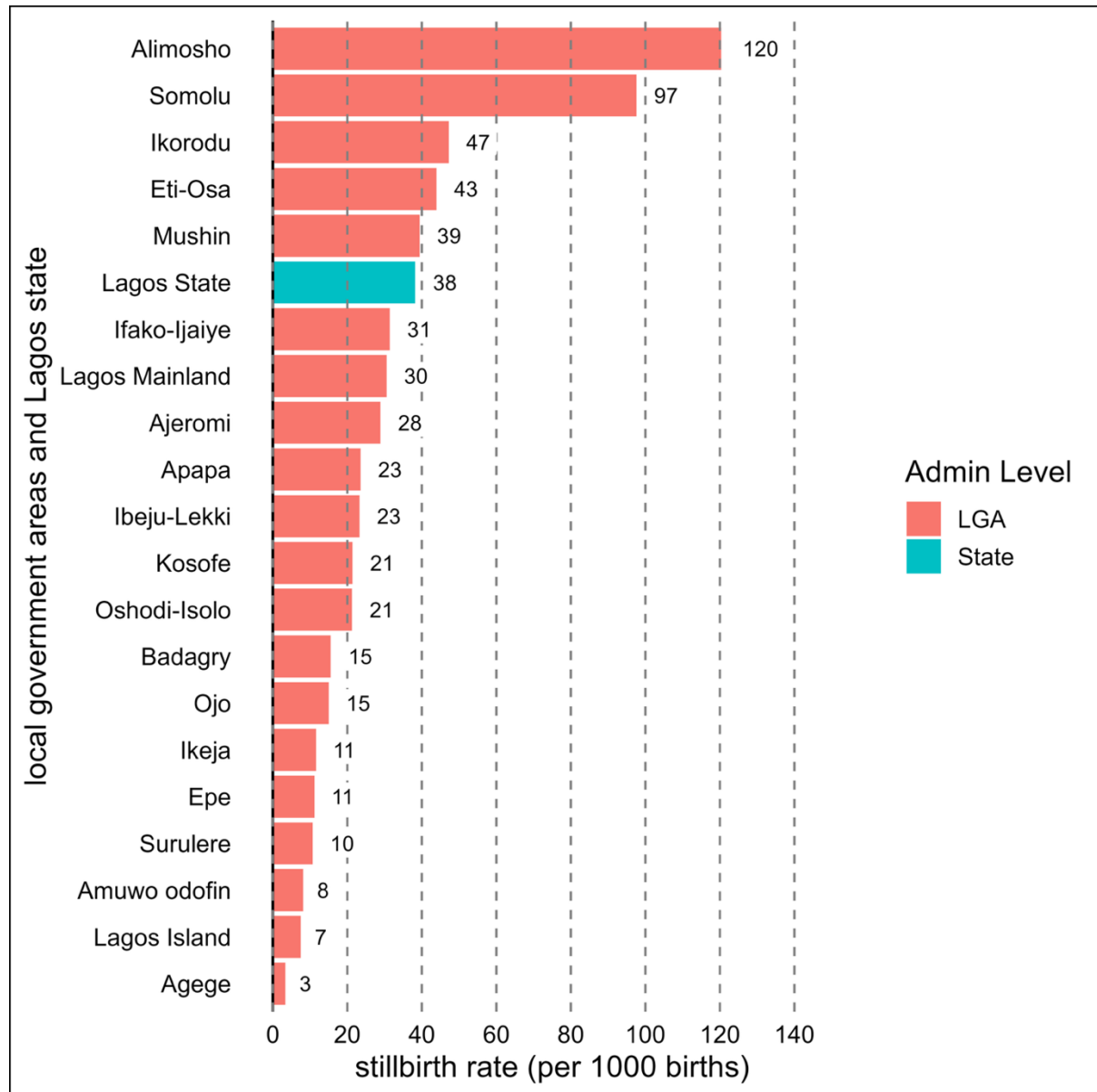


Figure 2: SBR estimates across the 20 local government areas and the state

4.2 Leading obstetric causes of maternal deaths in Lagos State

The VA findings from the retrospective surveillance phase revealed that maternal deaths in Lagos are predominantly driven by obstetric haemorrhage (36%), pregnancy-induced hypertension (22%), abortion-related death (10.2%), and ruptured uterus (8.5%), alongside other medical causes (Figure 4).

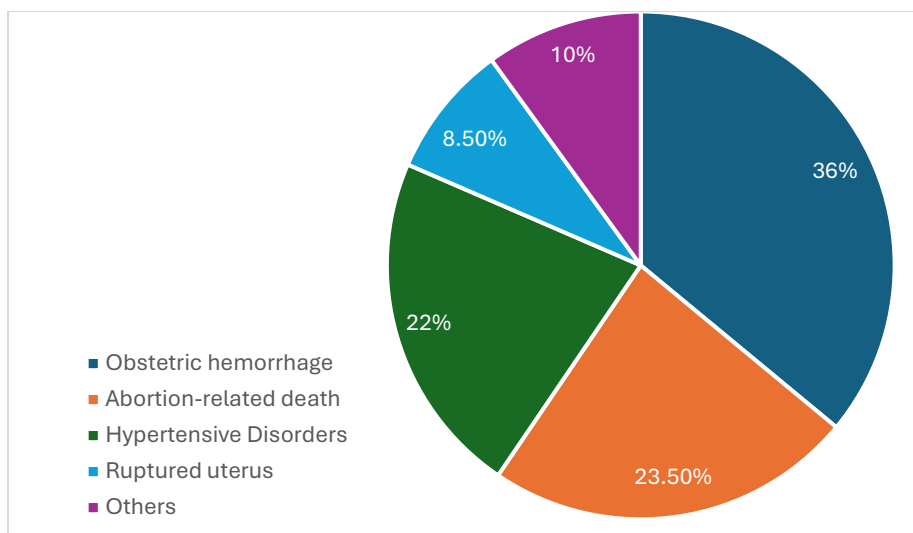


Figure 3: Causes of maternal mortality (based only on InterVA-5)

4.3 Social cultural causes of maternal deaths in Lagos State

Findings from the SA component highlighted that maternal deaths in Lagos State result from a complex interplay of socio-cultural norms, financial barriers, behavioural practices, and systemic constraints.

Delay 1 - Delay in deciding to seek care

The SA narratives revealed that a significant proportion of women and families delayed seeking healthcare due to limited recognition or underestimation of danger signs during pregnancy and labour. Another reason for the delay in deciding to seek care was the preference for traditional birth attendants, faith-based healers, or home remedies based on cultural norms, familiarity, lower costs, or prior positive experiences. Fear of poor staff attitudes, perceived disrespect, confidentiality concerns, or previous negative encounters at health facilities was another highlighted reason for this level of delay. Financial constraints and a lack of decision-making power within households were also identified as a cause of this level of delay.

Delay 2 - Delay in reaching a health facility

Some women who attempted to seek care experienced difficulty securing transportation during emergencies, especially at night, high transport costs or a lack of immediate funds, poor road conditions, particularly in peri-urban and waterfront settlements and inefficient referral pathways where facilities lacked capacity to stabilise or immediately transfer patients. These constraints resulted in prolonged travel times, worsening clinical conditions, and in some cases, death occurring en route.

Delay 3 - Delay in receiving adequate care at the facility

Even when women arrived at facilities, systemic issues impeded timely and appropriate care. These systemic issues included requests for payment before treatment or delays caused by administrative procedures; poor staff responsiveness, low provider-to-patient ratios, and perceived neglect; shortages of essential supplies, including blood, oxygen, and emergency medications; sub-optimal clinical management practices, prolonged referral loops, and weak internal escalation systems.

5 Recommendations

Based on LVASA-SRS evidence, the government should:

1. Prioritise the problem of maternal and perinatal mortality with emphasis placed on LGAs with highest MMR and SBR.
2. Initiate and sustain multi-pronged and targeted approaches to address the observed social determinants of health across the different delay phases and LGAs in Lagos.
3. Formally integrate key SRS components (VA/SA, community focal persons, digital dashboards) into MPDSR guidelines and tools.
4. Ensure provisions for community-level reporting, confidentiality, and non-punitive learning as part of a routine state-level cMPDSR that reports LGA-level MMR and SBR estimates as well as obstetric and social cause of maternal deaths in Lagos State.
5. Use social autopsy evidence to guide where and how to intervene in maternal and perinatal mortality reduction efforts.

6 Conclusion

LVASA-SRS has demonstrated that it is possible to directly count maternal deaths and stillbirths, determine their causes, and understand the social and health system pathways that lead to these outcomes across all LGAs in Lagos State. Through a combination of rigorous methods, digital innovations, community engagement, and strategic partnership with LSMOH and LSPHCB, the project has generated robust, first-of-its-kind estimates of MMR and SBR, a functional model for integrating community surveillance into MPDSR, a blueprint for incorporating SRS elements into routine state systems, and a path forward for strengthening CRVS and evidence-based decision-making. The next phase presents an opportunity for Lagos State to consolidate these gains,

formally embed SRS processes within its health system, and position itself as a national model for using high-quality mortality data to drive maternal and newborn health improvements.