

Research Article

Availability and Utilization of Tools for the Medical Certification of Causes of Death in Public Health Facilities in Senegal in 2025

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Abstract

Reliable data on causes of death are essential to guide health policy, yet fewer than one in ten deaths is medically certified in many sub-Saharan African countries. Since 2021, Senegal has progressively deployed a harmonized set of WHO-aligned death management tools, including a medical certificate of cause of death (MCCD); an initial 2023 assessment had revealed partial tool availability, frequent completion errors, and insufficient trained staff. A second national cross-sectional assessment was conducted in 2025, combining a facility-level structural audit with a systematic review of MCCDs completed in 2024, using a standardized digitized tool to record tool availability, utilization, and training coverage, and to score certificate content and form (score out of 30 points: poor ≤ 10 , medium 11–20, good 21–30); data were analyzed descriptively. Of 183 targeted facilities, 147 (80.3%) were supervised (27/39 public hospitals [EPS], 69.2%; 120/144 health centers [CS], 83.3%). MCCD availability exceeded 90% in most EPS clinical departments but fell to 50–60% in surgery and intensive care and was nil in mortuaries; in CS, clinical documents were available in 99% of cases, versus 69–70% for mortuary-related registers, and utilization was consistently lower than availability. Training coverage reached 72.8% of supervised EPS departments and 73% of supervised CS. Among 1,469 MCCDs examined, representing 25% of the 5,852 medically certified deaths recorded nationally in 2024, only 292 (19.9%) were of good quality, 596 (40.6%) of medium quality, and 581 (39.6%) of poor quality, with poor quality predominating throughout the year (35.0–48.9% by month). The interval between disease onset and death was most frequently left blank (77%), and the causal sequence showed the highest error rate (27%), most often recording a sign or mechanism of death instead of a diagnosis. Only 46% of certificates were written in capital letters, 79% were legible, 66% were free of abbreviations, and 77% were free of crossing-out. Training deficit was the most frequently reported obstacle (65.6% of facilities), followed by non-availability of tools (13.1%). After two years of implementing harmonized death management tools, this assessment shows improved tool availability in Senegal's public health facilities but reveals persistent gaps in effective utilization and, above all, in the technical quality of medical certification, which remains well below what is required for reliable mortality statistics. Sustained initial and continuing training, systematic supervision, and uniform tool availability, particularly in surgery,

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intensive care, and mortuary services, are needed to ensure reliable cause-of-death data for national health policy.

Keywords

Medical Certificate of Cause of Death, Vital Statistics, Mortality Surveillance, Data Quality, Senegal

1. Introduction

Mortality is a key indicator of population health status and health system performance. Accurate recording of causes of death is essential for guiding national health policies, feeding vital statistics, and meeting international epidemiological surveillance commitments [1]. Globally, progress in death registration remains slow: between 1980 and 2012, the proportion of deaths registered worldwide rose from only 36% to 38% [2]. More recent estimates confirm the persistence of substantial geographic disparities, with Africa remaining the region with the lowest registration rates [3]. According to the World Health Organization (WHO), nearly 40% of deaths occurring worldwide are not registered, only about 8% of deaths in low-income countries have a documented cause, and civil death registration covers only about 10% of the African Region [4]. This situation severely limits decision-makers' capacity to plan health interventions based on reliable evidence. Medical certification of causes of death, an essential tool for mortality surveillance, relies on the use of a medical certificate of cause of death (MCCD) that complies with the model recommended by WHO and the International Classification of Diseases (ICD-11) [5, 6]. This document makes it possible to identify the underlying cause of death through a structured causal sequence, an indispensable condition for reliable and internationally comparable coding of causes of death [7].

In Senegal, medical certification of causes of death has long suffered from a lack of harmonization and limited adherence to international standards. The heterogeneity of the forms used across health facilities (certificates, records, bulletins, attestations) and their incomplete nature reflected the absence, prior to the 2021 reform, of a unified death management framework, a situation comparable to findings from multi-country programs to strengthen civil registration and vital statistics [8]. Studies conducted in other African countries have documented similar gaps in practitioner training and availability of standardized tools, as well as the central but still insufficiently leveraged role of the health sector in strengthening these systems [9, 10]. In response to these findings, Senegal's Ministry of Health launched a reform of death management in health facilities in 2021, in partnership with the Data for Health Initiative (D4H) of Vital Strategies. This process led to the design and introduction of a harmonized set of death management tools, including an MCCD aligned with WHO recommendations, rolled out in referral hospitals starting in 2022 [11]. An initial internal programmatic assessment, conducted

in 2023 by the Ministry of Health and Public Hygiene (unpublished program data), had revealed partial availability of tools, frequent MCCD completion errors, and an insufficient number of trained staff. Corrective actions were subsequently undertaken, including a new supply of tools and training sessions for district chief medical officers. To ensure continuous monitoring and assess the impact of these measures, a second national supervision was deemed necessary. Elsewhere in Africa and beyond, structured training and audit-feedback interventions have been shown to produce rapid and measurable improvements in the completeness and accuracy of medical certification of causes of death: a national program in the United Republic of Tanzania nearly doubled the proportion of certificates coded according to ICD and usable within five years, through combined strengthening of governance, training, and technological tools [13]; a hospital intervention in Egypt substantially reduced the recording of a mechanism of death in place of an underlying cause after brief structured training [15]; and a systematic review with meta-analysis of 21 studies concluded that interactive workshops, online modules, and training-of-trainers could significantly reduce certification error rates and constituted a cost-effective strategy for strengthening civil registration systems worldwide [14]. In Senegal itself, a pilot study integrating verbal autopsy into civil registry offices in the Dakar region illustrated both the feasibility and the added value of strengthening the determination of cause of death within routine civil registration [12]. The present national assessment, conducted in May 2025 on data relating to the year 2024, had the following objectives: (i) to assess the level of availability and utilization of harmonized death management tools in public hospitals (public health facilities, EPS) and health centers (CS); (ii) to describe staff training coverage for these tools; (iii) to assess the technical quality of medical certification of causes of death based on a national sample of certificates; and (iv) to identify the main obstacles encountered by health facilities, in order to guide future corrective actions.

2. Methods

2.1. Study Setting

Senegal is a West African country covering 196,722 km², with a population estimated at more than 18 million in 2024.

The national territory is organized into 14 regional health directorates (DRS) and 79 health districts. The national health pyramid comprises three levels: central (Ministry), intermediate (regional health directorates), and peripheral (health districts). The targeted facilities were public hospitals (public health facilities, EPS), subdivided into level-1 EPS (first level of hospital referral), level-2 EPS or regional hospital centers (CHR), and level-3 EPS or national hospital centers (CHN), as well as public health centers (CS). Senegal had a total of 39 EPS and 144 public CS, i.e., 183 facilities targeted for supervision. As part of the harmonization of mortality data management tools in Senegal, since 2021 the Ministry in charge of Health of Senegal, through the Directorate of Planning, Research and Statistics (DPRS) and the Directorate of Public Health Facilities (DEPS), in collaboration with the D4H Initiative of Vital Strategies, has been promoting a standardized set of nine death management tools in health facilities: (1) the death notification form; (2) the declaration of violent or suspicious death, for cases involving a medico-legal obstacle, addressed to the public prosecutor; (3) the medical certificate of cause of death (MCCD), adapted from the WHO model and compliant with the ICD; (4) the death certificate for internal administrative use by the facility; (5) the death certificate intended for the civil registrar; (6) the clinical death register, compiling the three medical certificates; (7) the mortuary register, for tracking bodies; (8) the administrative death register, kept by the admissions office; and (9) the body release authorization register.

2.2. Study Type and Period

A national cross-sectional supervision assessment combining a structured facility survey with a systematic audit of medical certificates of cause of death was conducted. It covered the entire national territory. Data collection took place from May 19 to 31, 2025, and covered registers and certificates relating to the 2024 calendar year.

2.3. Study Population

2.3.1. Sampling Unit

The public health facility in Senegal providing inpatient care and likely to record deaths, namely public health facilities (EPS levels 1, 2, and 3) and public health centers (CS).

2.3.2. Statistical Units

Two statistical units were considered. The first was the health facility, for the assessment of the availability and utilization of harmonized death management tools as well as staff training coverage. The second was the medical certificate of cause of death (MCCD) issued for the year 2024, for the assessment of certification quality.

2.4. Sampling

2.4.1. Inclusion Criteria

All public health facilities in Senegal of the EPS (levels 1, 2, and 3) or CS type appearing on the national list were included, regardless of region. All medical certificates of cause of death issued in these facilities during the 2024 calendar year and available in the clinical death registers at the time of the supervision visit were included.

2.4.2. Exclusion Criteria

Private health facilities, health posts, facilities under the military health service, and targeted public facilities unavailable during the data collection period were excluded. Certificates relating to a year other than 2024, certificates being completed at the time of the team's visit, and certificates that were entirely illegible were excluded.

2.4.3. Sample Size

Exhaustive recruitment of the 183 targeted public health facilities was planned, comprising 39 EPS and 144 CS.

2.4.4. Sampling Technique

An exhaustive census was targeted at the facility level, with achieved coverage reported as the proportion of targeted facilities actually visited. At the certificate level, systematic sampling was applied: for each clinical department recording deaths, the first available MCCD for each calendar month of 2024 was selected, in order to provide balanced representation across the year while limiting the workload of field teams. This systematic sampling approach, chosen for operational feasibility within the two-week collection period allotted, does not constitute a random selection of certificates and therefore does not guarantee strict statistical representativeness of all medically certified deaths at the national level; the resulting 25% proportion is a consequence of this sampling design, not a pre-established random sampling fraction. Results relating to certification quality should accordingly be interpreted as describing the systematic sample actually examined, rather than as a statistically representative estimate of all certificates issued in 2024.

2.5. Data Collection

2.5.1. Assessment Procedure and Coverage

Each field team first reported to the regional health directorate before visiting the facilities under its jurisdiction. Within each facility, the team leader contacted the mortality/certification focal point, who accompanied the assessors to the relevant departments. In each department, the assessors administered the assessment tool to the physician present, reviewed the certificates in detail, corrected identified errors on site, and concluded the visit with a debriefing.

2.5.2. Data Collection Tools

A standardized quality assurance tool was developed during a multidisciplinary workshop bringing together the Directorate of Planning, Research and Statistics (DPRS), the Directorate of Public Health Facilities (DEPS), hospital physicians, and the local Vital Strategies team. The tool comprised two parts: part 1 recorded the availability of the tools, their level of utilization, training coverage, and the professional profile of the staff completing and trained in the tools; part 2 scored the technical quality of each sampled MCCD along two dimensions. These were: “content,” assessed item by item against the certificate’s mandatory fields, and “form,” covering legibility, absence of crossing-out, absence of abbreviations, and use of capital letters. The “content” criteria assessed covered ten elements: the identity of the deceased, the causal sequence considered overall as well as each of its three lines (immediate cause, intermediate cause, underlying cause), the manner of death, perinatal deaths, maternal deaths, other significant morbid conditions, and the interval between disease onset and death. These ten content criteria and the four form criteria mentioned above together made up the score out of 30 points. A composite score out of 30 points was calculated for each certificate and classified as poor quality (≤ 10 points), medium quality (11–20 points), or good quality (21–30 points). Standardization across assessors was sought through the joint orientation session described below (see “Data collection method”), but no independent double-scoring of the same certificate by several assessors, nor any formal calculation of inter-rater agreement, has been reported. The tool, initially designed on paper, was digitized as an electronic form (Google Forms) to allow real-time data collection and direct export to a spreadsheet for analysis. Assessors completed the form on site using a smartphone or tablet.

2.5.3. Data Collection Method

Terms of reference defined the objectives, the roles and responsibilities of supervisors, and the standardized procedure for each facility visit, structured in three steps: a guided tour of the facility by the mortality/certification focal point; interviews with key informants (head of nursing, physicians, mortuary manager, and admissions office); and a department-by-department review of medical certificates of cause of death. A total of 30 supervisors and 15 drivers were mobilized, organized into teams of three (a lead supervisor, a deputy supervisor, and a driver), with one team deployed per region except Dakar, which was allocated two teams owing to its higher density of health facilities. The designated supervisors (physicians serving as certification focal referents and representatives of the regional health directorates) completed an online orientation session covering the assessment tool, the electronic form, and the practical aspects of fieldwork. The DPRS, DEPS, and Vital Strategies teams provided continuous technical support throughout the two weeks of data collection, and errors identified on site were corrected with facility staff during a closing debriefing at each site.

2.5.4. Collection Period

Data collection took place from May 19 to 31, 2025, over two weeks, and covered registers and certificates relating to the 2024 calendar year.

2.6. Variables Studied

The variables studied were grouped into four categories. Facility characterization variables: region, health district, facility type (level 1, 2, or 3 EPS, CS), and clinical departments recording deaths. Structural variables: availability of each of the nine harmonized death management tools, level of effective tool utilization, staff training coverage, and professional profile of staff completing the tools and trained in their use. Certification quality variables: item-by-item compliance of MCCD mandatory fields (“content”); compliance with form criteria (legibility, absence of crossing-out, absence of abbreviations, use of capital letters); composite score out of 30 points and corresponding quality category (poor quality ≤ 10 points, medium quality 11–20 points, good quality 21–30 points). Finally, obstacles to medical certification of causes of death reported by facility teams during interviews.

2.7. Analysis

Data exported from the electronic form were subjected to descriptive analysis. Categorical variables (tool availability, utilization, training status, quality category, compliance with form criteria, and reported problems) are summarized as frequencies and percentages, overall and by facility type (EPS versus CS) and, for quality indicators, by month and quarter of the year 2024. No inferential statistical test (e.g., comparison of proportions between groups, regression modeling) was performed in the source supervision report; results are therefore presented descriptively, consistent with the original data. Analyses were performed using R version 4.3.2.

2.8. Ethical Considerations

This work was conducted as part of routine national programmatic supervision falling under the quality assurance mandate of Senegal’s Ministry of Health and Public Hygiene, in partnership with the D4H Initiative of Vital Strategies, and did not involve the extraction of patient identifiers for the purposes of this analysis.

3. Results

A total of 147 health facilities were supervised, comprising 27 EPS and 120 CS, out of the 183 targeted facilities (39 EPS and 144 CS), corresponding to a national supervision coverage of 80.3%.

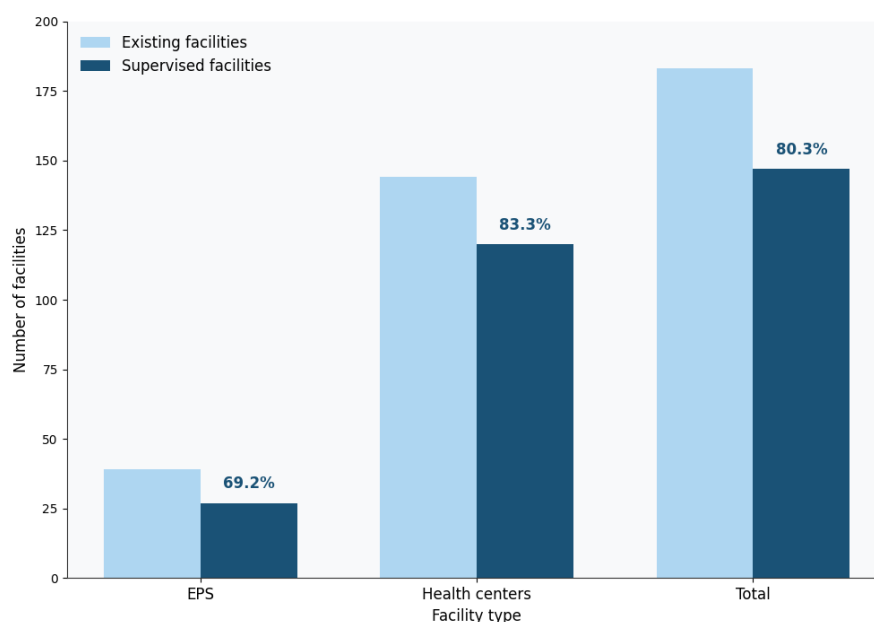


Figure 1. Coverage of the assessment by type of health facility, Senegal, 2024.

In the EPS, 27 of the 39 facilities were visited (coverage of 69.2%), comprising 5 level-1 EPS, 18 level-2 EPS (CHR), 4 level-3 EPS (CHN), and 2 EPS with quasi-public status; 122 clinical departments were assessed there. In the CS, 120 of the 144 facilities were supervised (83.3%); the detailed indicators of availability, utilization, and training below are reported for the 97 CS with complete data. For the remaining 23 CS, the structural questionnaire was incomplete at the time of data validation; these facilities were excluded from the tool-level indicators presented below (Table 1, panels D-F; Figure 2) while remaining included in the overall facility-level coverage count reported above. The specific reasons for incomplete

data collection at these 23 facilities were not systematically documented in the supervision dataset.

3.1. Structural Indicators: Availability, Utilization, and Training

Table 1 summarizes, for the EPS and CS, the availability and utilization of death management tools by clinical department or by tool, the main professional profile of the staff completing them, and training coverage by professional profile.

Table 1. Availability, utilization, and staff training in death management tools, by facility type, clinical department, and tool, Senegal, 2024 (consolidated data).

Item	n	Availability (%)	Utilization (%)	Main staff profile / Trained (%)
A. Public health facilities (EPS) - Availability and utilization of the MCCD by clinical department (122 departments assessed across 27 EPS)				
Emergency department (SAU)	23	96%	74%	-
Internal medicine	19	100%	79%	-
Pediatrics	13	92%	77%	-
Maternity/gynecology	13	100%	77%	-
General surgery	20	50%	50%	-
Intensive care	15	60%	47%	-
Cardiology	2	100%	100%	-

Item	n	Availability (%)	Utilization (%)	Main staff profile / Trained (%)
Orthopedics/traumatology	2	100%	100%	-
Mortuary	3	0%	0%	-
B. EPS - Main staff profile completing the tools				
Death notification form	-	-	-	Physician (85%)
Declaration of violent/suspicious death	-	-	-	Physician (86%)
Clinical death register (MCCD)	-	-	-	Physician (81%)
Administrative register	-	-	-	Admissions/administrative office (71%)
Body release authorization register	-	-	-	Admissions/administrative office (88%)
Mortuary register	-	-	-	Mortuary manager/senior staff (97%)
C. EPS - Staff trained in death management (75/103 departments with reported training data, i.e., 72.8%)				
Physicians	82	-	-	39%
Department supervisors	27	-	-	13%
Administrative staff	26	-	-	13%
Hospital interns	23	-	-	11%
Medical students	22	-	-	11%
Mortuary managers	18	-	-	9%
Other categories	9	-	-	4%
Midwives	1	-	-	0%
Total trained	208	-	-	100%
D. Health centers (CS) - Availability and utilization of tools (N=97 CS with complete data, out of 120 CS assessed)				
Death notification form	97	99%	76%	-
Declaration of violent/suspicious death	97	99%	63%	-
Medical certificate of cause of death (MCCD)	97	99%	66%	-
Death certificate (internal administrative use)	97	99%	71%	-
Death certificate (civil registrar)	97	99%	72%	-
Administrative death register	97	88%	51%	-
Mortuary register	97	70%	25%	-
Body release authorization register	97	69%	19%	-
E. CS - Main staff profile completing the tools				
Death notification form	-	-	-	Physician (74%)
Declaration of violent/suspicious death	-	-	-	Physician (83%)
Clinical register (MCCD)	-	-	-	Physician (78%)
Administrative register	-	-	-	Physician 27%; nurses 22%, students 11%, interns 17%, midwives 14%
Body release authorization register	-	-	-	Physician (41%) + interns (30%)
Mortuary register	-	-	-	Mortuary manager (71%)

Item	n	Availability (%)	Utilization (%)	Main staff profile / Trained (%)
F. CS - Staff trained in death management (71/97 CS trained, i.e., 73%)				
Physicians	66	-	-	40%
Medical students	27	-	-	17%
Department supervisors	23	-	-	14%
Head nurse (ICP)	17	-	-	10%
State-certified midwife (SFE)	13	-	-	8%
Administrative staff	6	-	-	4%
Mortuary managers	6	-	-	4%
Hospital interns	3	-	-	2%
Other categories	2	-	-	1%
Total trained	163	-	-	100%

MCCD availability in the EPS was particularly high in the emergency department (96%), internal medicine (100%), and pediatrics and maternity (100%), and markedly lower in general surgery (50%), intensive care (60%), and mortuaries (0%)

(Table 1, panel A). MCCD utilization was consistently lower than its availability, including in high-volume departments such as the emergency department (74%) and general surgery (50%).

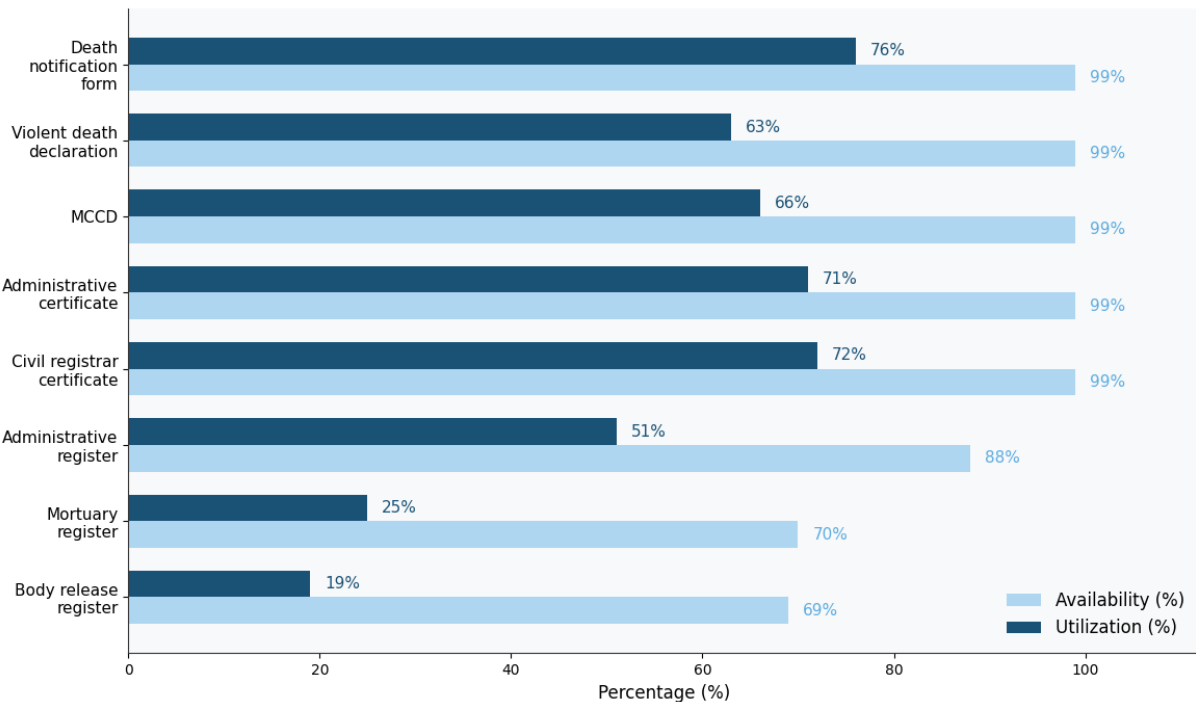


Figure 2. Comparative availability and utilization of death management tools in health centers, Senegal 2024 (N=97).

In the CS, tool availability was generally satisfactory for clinical documents (99% for the death notification form, the declaration of violent death, the MCCD, and both types of death certificates), but markedly lower for mortuary-related tools (70% and 69%, respectively, for the mortuary register

and the body release register) (Table 1, panel D, Figure 2). Here again, effective utilization remained well below availability, with the death notification form being the most used tool (76%) and mortuary-related registers the least used (19-25%).

Training coverage reached 72.8% of EPS departments that reported training data and 73% of supervised CS (Table 1, panels C and F, Figure 3). In both facility types, physicians

constituted the main category of trained staff (39% in EPS, 40% in CS).

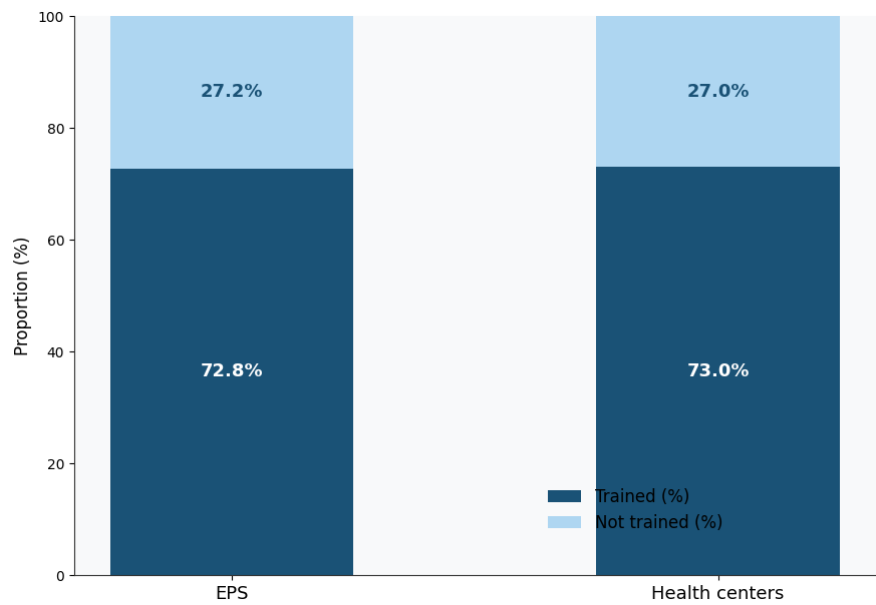


Figure 3. Coverage of death management training by type of health facility, 2024.

3.2. Quality of Medical Certification of Causes of Death

During the assessment, 1,469 medical certificates of cause

of death were examined, representing 25% of the 5,852 medically certified deaths recorded nationally in 2024. Table 2 presents the overall quality of certification, compliance with certificate form requirements, and the main problems identified during supervision.

Table 2. Quality of medical certification of causes of death, form compliance, and main problems identified, Senegal, 2024 (consolidated data).

Item	n	%	Additional detail
A. Overall certification quality (N=1,469 MCCDs examined, 2024)			
Poor quality (score ≤10 points)	581	39.6%	-
Medium quality (score 11-20 points)	596	40.6%	-
Good quality (score 21-30 points)	292	19.9%	-
Total	1,469	100%	-
B. Certificate form compliance (N=1,469)			
Written in capital letters	-	46%	non-compliant: 54%
Legibility	-	79%	non-compliant: 21%
Absence of abbreviations	-	66%	non-compliant: 34%
Absence of crossing-out	-	77%	non-compliant: 23%
C. Main problems identified during supervision (183 facilities)			
Training deficit	120	65.6%	-
Non-availability of tools	24	13.1%	-

Item	n	%	Additional detail
Incomplete tool completion	11	6.0%	-
Non-utilization of available tools	6	3.3%	-
Lack of staff buy-in	4	2.2%	-
Resupply delay (reprography)	4	2.2%	-
Absence of a dedicated focal point	4	2.2%	-
Poor register archiving	3	1.6%	-
Total absence of training	3	1.6%	-
Distribution of tools pending	3	1.6%	-
Late utilization of tools	1	0.5%	-
Total	183	100%	-

Percentages in panel B (certificate form compliance) are calculated on the full sample of 1,469 MCCDs examined (panel A); the source supervision dataset recorded these four form-compliance items as percentages only, without corresponding numerator counts, which could therefore not be reconstructed here without risk of inaccuracy.

Poor-quality certificates predominated throughout the year,

with a peak in January (48.9%) and minimum values in March (35.0%) and September (35.8%). Medium-quality certificates increased between the first and second quarters, with a peak in May (49.2%). Good-quality certificates remained below 26% throughout the year, with the lowest values observed in May and June (15.4% and 13.0%, respectively) (Figures 4 to 6).

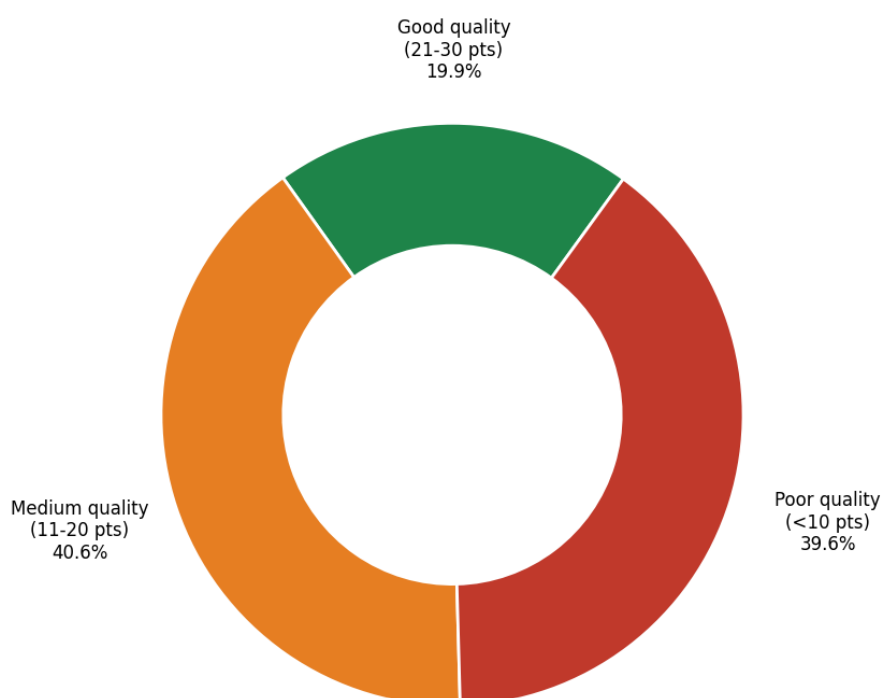


Figure 4. Overall distribution of the quality of medical certification of causes of death, N=1,469, 2024.

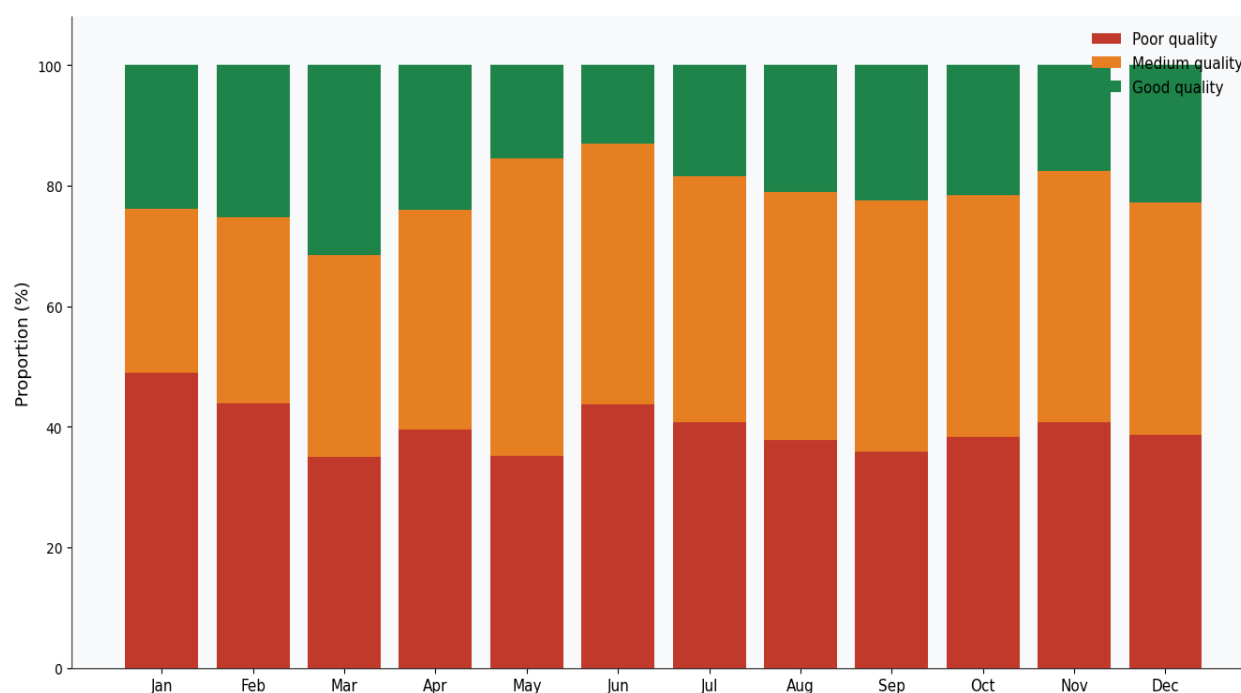


Figure 5. Monthly trend in the quality of medical certification of causes of death, 2024.

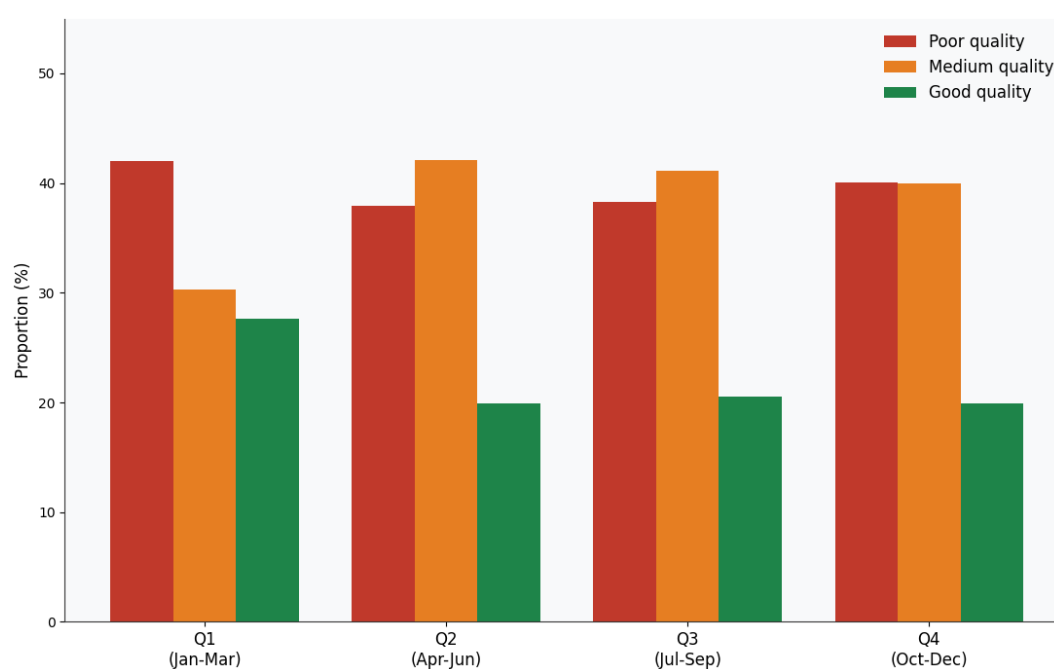


Figure 6. Quarterly trend in the quality of medical certification of causes of death, 2024.

Review of certificate content revealed two main categories of error: missing entries for certain fields, and incorrect entries. The interval between disease onset and death was the field most frequently left blank (77%), followed by other significant morbid conditions (75%), maternal deaths (75%), and

perinatal deaths (69%). The causal sequence itself, although central to certification, was absent in 34% of certificates. Deceased identity had the lowest non-completion rate (20%) (Figure 7).

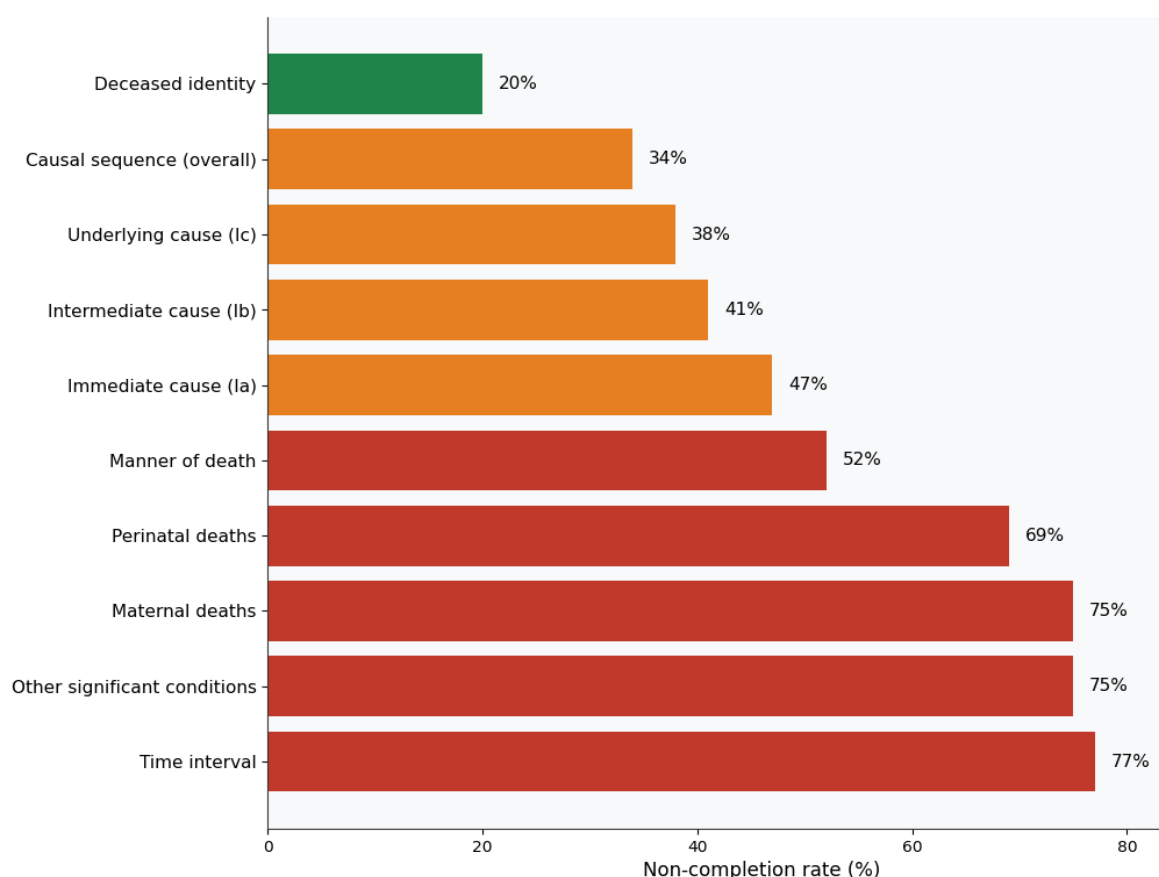


Figure 7. Non-completion rate of the main fields of the medical certificate of cause of death (MCCD).

Among completed causal sequences, the causal sequence block had the highest content error rate (27%). The most frequently observed errors were: (i) recording a clinical sign or mechanism of death (e.g., “fever,” “dyspnea,” “cardiac arrest,” or “circulatory arrest”) instead of a diagnosis of the underlying cause; (ii) lines left blank between successive causes in the causal sequence, in violation of WHO certification rules; (iii) line (a), intended to record the immediate cause of death, left blank; and (iv) inversion of the causal sequence, with the terminal (immediate) cause recorded at the bottom of the sequence instead of on line (a), which should be the first line. Review of certificate form revealed major non-compliance. Only 46% of certificates were written in capital letters, as required by national certification rules. Legibility reached 79%. Abbreviations were present in 34% of certificates and crossing-out in 23% (Table 2, panel B).

3.3. Obstacles Identified During the Assessment

Training deficit was by far the most frequently reported

problem among the facilities visited (65.6%). It reflected either insufficient or absent initial training for some practitioners, or a lack of continuing training for staff recruited since the initial training waves. Non-availability of tools accounted for 13.1% of reported problems, related to inadequate initial supply in some facilities, delays in reprographic resupply, or ordering delays. In 3.3% of facilities, available tools were not used, and in 2.2%, tools were present in the facility but had not yet been distributed to departments. Organizational problems accounted for a more modest but non-negligible share: 2.2% of facilities reported the absence of a focal point dedicated to death management, 2.2% reported a lack of staff buy-in, and 1.6% reported poor register archiving (Table 2, panel C, Figure 8). These obstacles correspond to problems reported qualitatively and declaratively by the facility teams themselves during interviews; this assessment did not statistically compare certificate quality according to the training status of the staff who completed them, and the training deficit should therefore be interpreted as a programmatic priority strongly suggested by these findings rather than as a demonstrated causal determinant of certification quality.

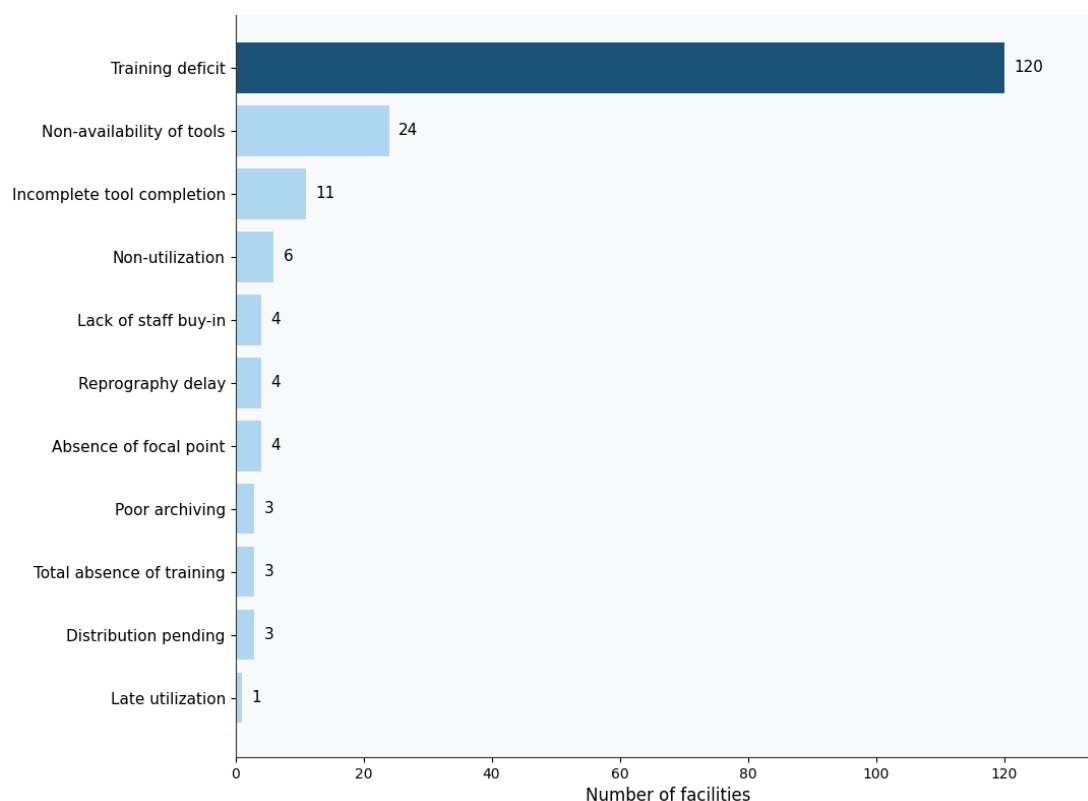


Figure 8. Distribution of problems identified during the national assessment, 2024.

4. Discussion

This national assessment, covering 80.3% of health facilities and 25% of medically certified deaths recorded nationally in 2024, provides the most comprehensive assessment to date of the harmonized death management tools introduced in Senegal since 2022. Three findings merit particular attention: the persistence of a substantial gap in the quality of medical certification, with only 19.9% of certificates rated as good quality; markedly lower availability, utilization, and training coverage in health centers (CS) than in public hospitals (EPS); and the identification of training deficit as the main obstacle, reported in 65.6% of facilities. The observed proportion of good-quality certificates (19.9%) is lower than the progress reported after several years of implementing a structured national program in the United Republic of Tanzania, where combined strengthening of governance, training, and technological tools nearly doubled the proportion of certificates coded according to ICD and usable over a five-year period [13]. It nonetheless remains consistent with international data summarized by a systematic review and meta-analysis of 21 training intervention studies, which concluded that structured training substantially reduced, but rarely eliminated, certification errors, and that repeated and reinforced interventions were generally necessary to achieve lasting gains [14]. The profile of content errors identified here (causal sequence blocks left blank or completed with a mechanism of death rather than a diagnosis of

underlying cause, blank lines within the causal sequence, and sequence inversion) closely matches the types of errors that a brief, structured training intervention was able to reduce in a hospital study in Egypt [15], suggesting that comparable training modules, targeting completion of the causal sequence and inexpensive to deploy, could produce tangible gains if systematically deployed and reinforced across all Senegalese facilities. These findings also echo the broader difficulty of establishing complete and well-documented civil registration and vital statistics (CRVS) systems in low- and middle-income settings, where the health sector is increasingly recognized as a critical, yet still underutilized, entry point for closing data quality gaps [10]. The persistence of both content and form errors identified, notably the low proportion of certificates written in capital letters (46%) and the presence of abbreviations (34%) and crossing-out (23%), indicates that quality improvement in this context cannot rely on training alone, and must also address practical and operational aspects of certificate completion (legibility, standardized handwriting, point-of-care job aids). The consistently lower availability, utilization, and training coverage observed in health centers compared with public hospitals suggest a structural, rather than incidental, gap. Health centers generally have fewer physicians, experience higher staff turnover, and are harder to reach for centralized training and supply chain activities than referral hospitals; constraints well documented in analyses of health-sector approaches to strengthening CRVS systems in resource-limited settings [9, 10]. CS handle a substantial share of the country's first points of care contact, and therefore of

community deaths. This gap is likely to translate into a disproportionate share of national deaths for which cause-of-death information is missing, incomplete, or of lower quality, with a corresponding risk of bias in aggregated national cause-of-death statistics if this shortfall is not specifically addressed. Training deficit was the most frequently cited obstacle (65.6% of facilities), far ahead of tool non-availability (13.1%) and all other problems identified. This finding is consistent with the 2023 internal assessment, which had already identified an insufficient number of trained staff as a major constraint, and indicates that training gaps have persisted despite the corrective actions undertaken between the two assessment cycles. It also aligns with international evidence that structured, iterative training, rather than a single initial session, is necessary to achieve and sustain improvements in certification quality [13, 14]. The relatively modest share of facilities reporting tool non-availability (13.1%) suggests that, unlike in earlier phases of the reform, tool distribution logistics is no longer the main constraint; the priority for the next phase of the program should therefore focus on reducing the training deficit, particularly for staff recruited or assigned to facilities after the initial training waves. The pronounced availability-utilization gap observed for mortuary-related tools in CS (69-70% availability but only 19-25% utilization) most plausibly reflects the circulation of bodies in this system: many deaths occurring in or referred from a CS are transferred to a hospital mortuary, or directly to the family, without an on-site mortuary stay, so that the mortuary register, even where available, is not always applicable at the health-center level. This assessment did not collect facility-level data on body referral patterns, so this interpretation should be regarded as a plausible hypothesis to be confirmed by further targeted data collection, rather than an established explanation.

These findings must be interpreted in light of the strengths and limitations of the assessment design. Supervision covered 80.3% of targeted public facilities, with differentiated coverage by facility type (69.2% of EPS versus 83.3% of CS). This corresponds to substantial national coverage of targeted public health facilities rather than to a statistically representative sample in the strict sense, two years after the nationwide rollout of harmonized death management tools. By combining structural indicators with certificate content quality, the assessment offers a multidimensional view of the death management chain. It also situates corrective actions within an ongoing quality improvement process. These strengths must nonetheless be weighed against several limitations. Coverage remains incomplete, and the 36 unassessed facilities could differ systematically from those visited. This uneven coverage across facility types calls for particular caution in any EPS/CS comparison based solely on the facilities actually visited. The descriptive and cross-sectional nature of the design precludes any causal inference, as well as any formal statistical comparison with the 2023 cycle, and in particular does not make it possible to establish whether certificates completed by trained

staff were in fact of better quality than those completed by untrained staff. These caveats invite reading the results as a reliable snapshot of national orders of magnitude, rather than as a precise measure of their change over time. The specific reasons for non-supervision of the 36 remaining facilities (e.g., scheduling constraints within the two-week collection period, temporary facility closure, or unavailability of key staff at the time of the planned visit) were not systematically documented for each facility, which limits any formal assessment of selection bias beyond the coverage-rate comparison presented above. In addition, the quality-score thresholds used to classify certificates as poor (≤ 10), medium (11-20), or good (21-30 points out of 30) are pre-defined programmatic cutoffs, applied consistently since the 2023 assessment cycle to allow comparability over time, rather than thresholds empirically validated against an external reference standard; this should be taken into account when interpreting the quality categories reported here.

5. Conclusion

After two years of implementing a harmonized set of death management tools in Senegal's public health facilities, this second national assessment highlights improvements in tool availability but reveals the persistence of substantial gaps in their utilization and in the technical quality of medical certification of causes of death: mission coverage reached 80.3%, and most facilities visited had at least partial availability of the tools and used them, yet only 19.9% of the 1,469 medical certificates of cause of death examined were of good quality, with marked disparities to the detriment of health centers compared with public hospitals. Training deficit was identified as the main obstacle in nearly two-thirds of facilities. These results suggest that the quality of medical certification of causes of death, more than the mere availability of tools, now constitutes the main bottleneck for reliable mortality surveillance in Senegal.

6. Recommendations

Closing this gap will require sustained and strengthened training, particularly in health centers, integrated into a continuous cycle of supervision and feedback. Reinforced and repeated training on completing the causal sequence should explicitly target the documented errors (blank lines within the sequence, recording a mechanism of death rather than an underlying cause, sequence inversion), complemented by systematic induction training for newly recruited or reassigned staff, so that coverage already achieved is not eroded by staff turnover between supervision cycles. Closing the gap between health centers and public hospitals deserves to be treated as a distinct programmatic priority, while form non-compliance (legibility, use of capital letters, abbreviations, and crossing-out) can be addressed through simple job aids and reminders

at the point of care, deployed alongside content-focused modules. Beyond these measures, three further interventions could help translate training gains into durable improvements in certification quality: integrating WHO/ICD medical certification guidelines into pre-service medical curricula, so that certification skills are acquired before entry into practice rather than solely through post-hoc supervision; establishing institutional death audit committees at hospital and district level to periodically

review certificate quality and provide structured feedback to certifying physicians; and progressively transitioning toward electronic certification systems, which can embed real-time completeness and consistency checks and thereby help reduce the content and form errors identified in this assessment. Finally, embedding these actions within a national cycle of formative supervision and data quality auditing would make it possible to statistically quantify progress and durably consolidate the expected quality gains.

Abbreviations

MCCD	Medical Certificate of Cause of Death
WHO	World Health Organization
ICD	International Classification of Diseases
CRVS	Civil Registration and Vital Statistics
D4H	Data for Health Initiative
EPS	Public Health Facility (Établissement Public de Santé)
CS	Health Center (Centre de Santé)
CHR	Regional Hospital Center (Centre Hospitalier Régional)
CHN	National Hospital Center (Centre Hospitalier National)
DRS	Regional Health Directorate (Direction Régionale de la Santé)
DPRS	Directorate of Planning, Research and Statistics
DEPS	Directorate of Public Health Facilities (Direction des Établissements Publics de Santé)
SAU	Emergency Department (Service d'Accueil des Urgences)
ICP	Head Nurse (Infirmier Chef de Poste)
SFE	State-Certified Midwife (Sage-Femme d'État)

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Conflicts of Interest

The authors declare no conflicts of interest.

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