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A National Survey on Maternal and Perinatal Mortality Surveillance and Response in Senegal in 2024: Challenges and Prospects

Thiam O[1]*, Ndoye M[2] and Niang K[2]

[1]*Department of Maternal, Child, and Adolescent Health, Gaston Berger University, Saint-Louis, Senegal.*

[2]*Department of Public Health, Gaston Berger University, Saint-Louis, Senegal.*

***Correspondence:**
Ousmane Thiam, Department of Maternal, Child, and Adolescent Health, Gaston Berger University, Saint-Louis, Senegal.

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ABSTRACT

Objective: *The objective of this study was to establish the epidemiological and clinical profile of maternal deaths from 2019 to 2020 in healthcare facilities in the 14 regions of Senegal between January 1, 2019, and December 31, 2020.*

Methodology: *The cross-sectional retrospective study included all cases of maternal deaths meeting the WHO definition, following a process of collecting maternal death notification forms at the medical region level. The parameters studied concerned the availability of forms, sociodemographic characteristics, and clinical data extracted from death notification forms. The data, entered using a digital platform developed for this purpose, were analyzed using R software.*

Results: *The age of death ranged from 13 to 46 years and from 14 to 48 years. The average age increased from 28.4 (±6.9) years to 28.9 (±7.2) years. Gestation differentiated more multigravidas (49.6%-57.2%) than oligogravias (27.6%-21.9%) and primigravidas (22.8%-20.9%). Parity differentiated multiparous women (30.1%–41.8%), multiparous women (20.7%–18.3%), primiparous women (15.0%–15.1%), and nulliparous women (34.1%–24.8%). Medical history was dominated by diabetes (27.3%–24.3%), hypertension (23.7%–18.9%), and malaria (1.1%–2.3%). The gynecological and obstetric history was mainly less than four antenatal care visits (75.5%–73.7%) and at least one abortion (26.4%–25.8%). Referrals increased from 48.9% to 59.0%; deliveries in a public health facility from 60.9% to 65.0%, duration of labor from 7.2 (±4.3) hours to 6.9 (±5.3) hours, vaginal delivery from 50.2% to 48.9%, and cesarean section from 49.8% to 51.1%. The period of death was postpartum (68.7%–77.3%) and pregnancy (19.4%–15.0%). The place of death was a health facility (90.5%, of which 73.4% were public health facilities). The area of death was predominantly urban (93.3%–92.4%). The causes of death were dominated by hemorrhage (32.1%–32.7%), hypertension and its complications (28.7%–22.7%), anemia (6%–13%), infections (5.3%–4.5%), abortion (0.8%–0.6%), dystocia (0.8%-1.8%), malaria (0.4%-0.0%), HIV infection (0.4%-0%), other causes (19.6%-13.0%), and unknown causes (6.0%-7.3%).*

Conclusion: *Maternal mortality is a major public health issue. Maternal mortality remains very high worldwide and varies from region to region. The typical profile of maternal deaths was women aged 25-35, multiparous with no history of abortion, who had attended fewer than four antenatal care visits and who died after referral to a public health facility, less than 48 hours after a cesarean section, as a result of hemorrhage, hypertension, or complications from giving birth to a live child.*

Keywords
Mortality, Maternal, Senegal, SDMPR.

Introduction
In 2017, the World Health Organization (WHO) reported that 295,000 women died from complications related to pregnancy and childbirth. Approximately 99% of these deaths occurred in developing countries and most were preventable [1,2].

Between 1990 and 2015, the global maternal mortality ratio (number of maternal deaths per 100,000 live births) decreased by only 2.3% per year. However, the decline in maternal mortality

accelerated after 2000. In some countries, the annual maternal mortality rate between 2000 and 2010 was above 5.5%, which is the threshold required to achieve the Millennium Development Goals (MDGs) [4].

Sub-Saharan Africa is the most affected region, accounting for 66% of estimated global maternal deaths in 2017, with an average mortality rate of 564 per 100,000 live births (LB), compared to 183 in North Africa, 480 in East Africa, 509 in Central Africa, and 339 in Southern Africa. These regional averages mask significant variations, with maternal mortality rates (MMR) ranging from 53 maternal deaths per 100,000 LB in the Seychelles to 1,150 maternal deaths per 100,000 LB in South Sudan [2-5]. Still in sub-Saharan Africa, the lifetime risk of maternal mortality for a 15-year-old girl was 1 in 37, compared to 1 in 4,800 for a girl of the same age in Europe or North America [6].

In Senegal, the MMR fell from 512 deaths to 236 deaths per 100,000 live births between 1992 and 2017 [7,8]. The causes of maternal mortality are well known; they are mainly direct medical causes, the most common of which in Senegal in 2020 were hemorrhage (37.2%) and high blood pressure and its complications (22.7%) [9,10].

Despite the efforts made with the MDGs and SDGs, the mortality rate remains high, which shows that the measures taken have been ineffective.

To address this issue, the WHO has implemented tools to combat maternal mortality, including the Maternal Death Surveillance and Response (MDSR) strategy [11]. This form of continuous surveillance establishes a bridge between the health information system and quality improvement processes, from the local to the national level. It made it possible to systematically identify, report, quantify, and determine the causes of maternal deaths and, where possible, prevent them. Encouraged by the WHO, Senegal committed to using Maternal Death Reviews (MDRs) through the MDRS as a tool for improving the quality of care. It is with thi e in mind that we conducted a study on the epidemiological and etiological profile of maternal deaths in public health facilities (EPS) and districts in Senegal. The aim of this study is to contribute to the reduction of maternal mortality.

The overall objective is to establish an epidemiological and clinical profile of maternal deaths in healthcare facilities in the 14 regions of Senegal for the period from January 1, 2019, to December 31, 2020. The specific objectives were to define the profile of deceased patients, identify the causes of maternal deaths, and assess the availability of death notification forms.

Methodology

This is a retrospective cross-sectional study of maternal deaths in all health facilities in Senegal. Only deaths occurring between January 1, 2019, and December 31, 2020, were included in this study. Data collection was carried out using notification forms at regional health directorates, public health facilities, and health districts in the 14 regions from March 24 to April 30, 2024. It covered all patients who died during pregnancy, childbirth, and the postpartum period during the study period in Senegalese health facilities. As the data from the forms was entered on a digital platform, no additional data entry was necessary. The databases, which were available immediately after data collection, were cleaned and analyzed. Descriptive analysis was performed by determining standard position and dispersion parameters (frequencies, mean, standard deviation, median, extremes) using R software. Standard tables and figures were used to illustrate these descriptive results. The variables studied were sociodemographic data (age, gestation, parity, history, prenatal consultation), clinical data (mode of admission, pregnancy outcome, place of delivery, pathologies and causes of death, fate of the child, sex of the child, place of death, time of death), and maternal death audits. The study protocol was submitted to the Senegalese National Health Research Ethics Committee (CNERS) for ethical and scientific review. The death certificates collected included personal identification data on the deceased, as well as on the provider who made the notification. Due to the sensitivity of this information, the selected investigators were briefed on the confidentiality of the data collected. After processing, the data sources and the resulting databases were secured. A password held solely by the principal investigator was required to access the online server. Only the principal investigator had access to it.

Results

Availability of forms at the medical region level

Table 1 illustrates the distribution of data availability at the medical region level.

Taking the results of the SRMNIA reviews as expected forms, the availability of 2019 maternal death notification forms is 40.0% (682 expected forms versus 273 available). This proportion is 42.7% for 2020 forms (797 expected forms versus 340 available). The medical regions of Kaffrine, Kédougou, and Thiès have more forms than expected for 2019. For 2020, no maternal death notification forms were available in the medical regions of Fatick and Louga. The regions of Kaffrine and Thiès had the highest availability of death notification forms for 2020.

Sociodemographic characteristics

- **Age**

The average age of women who died was 28.4 ± 6.9 in 2019 and 28.9 ± 7.2 in 2020. Table VIII illustrates the age parameters of women who died from 2019 to 2020**.**

Figure 1 illustrates the distribution of deceased women by age group.

The 25-35 age group remained the most representative in both 2019 and 2020.

Table 1: Availability of forms at the medical region level.

Year	Medical regions	Forms expected	Forms available *n*	
2019	Dakar	73	1	*(1.4)*
	Diourbel	77	25	*(32.5)*
	Fatick	24	7	*(29.2)*
	Kaffrine	28	31	*(110.7)*
	Kaolack	68	43	*(63.2)*
	Kédougou	22	23	*(104.5)*
	Kolda	43	8	*(18.6)*
	Louga	27	5	*(18.5)*
	Matam	45	1	*(2.2)*
	Saint Louis	57	33	*(57.9)*
	Sédhiou	21	1	*(4.8)*
	Tambacounda	102	17	*(16.7)*
	Thiès	66	67	*(101.5)*
	Ziguinchor	29	11	*(37.9)*
Total 2019		**682**	**273**	***(40.0)***
2020	Dakar	99	19	*(19.2)*
	Diourbel	86	53	*(61.6)*
	Fatick	26	0	*(0.0)*
	Kaffrine	35	32	*(91.4)*
	Kaolack	61	27	*(44.3)*
	Kédougou	29	15	*(51.7)*
	Kolda	40	7	*(17.5)*
	Louga	57	0	*(0.0)*
	Matam	56	42	*(75.0)*
	Saint Louis	53	39	*(73.6)*
	Sédhiou	37	1	*(2.7)*
	Tambacounda	102	33	*(32.4)*
	Thiès	87	70	*(80.5)*
	Ziguinchor	29	2	*(6.9)*
Total 2020		**797**	**340**	***(42.7)***

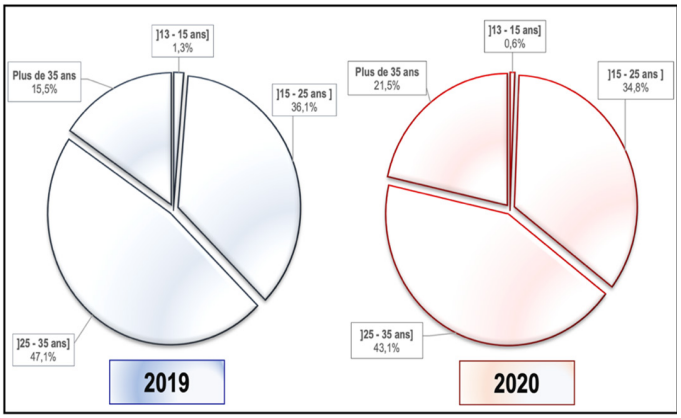

Figure 1: Distribution of deceased women by age group [11].

Medical and obstetric history of the woman

- Medical history

Diabetes and high blood pressure were the most common intercurrent conditions among women who died. High blood pressure was found in 23.7% of women who died in 2019 and 18.9% in 2020. The corresponding figures for diabetes were 27.3% and 24.3%.

Figure 2 illustrates the prevalence of intercurrent diseases in women who died in 2019 and 2020.

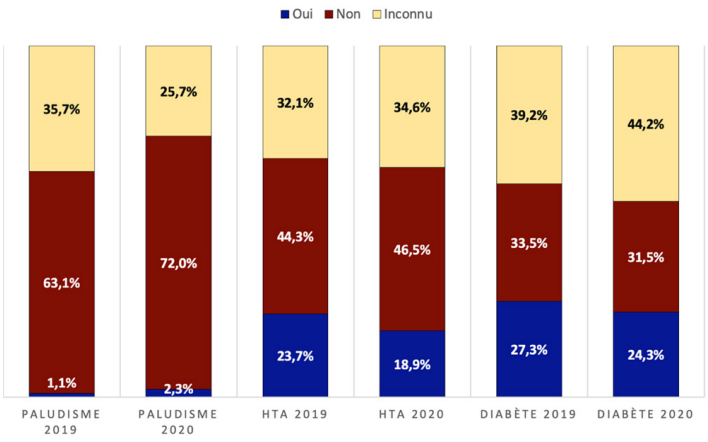

Figure 2: Prevalence of intercurrent diseases among women who died in 2019 and 2020 [11].

Gynecological and obstetric history

- Gestation and parity

The women who died were mainly multigravida in 2019 (49.6%) and 2020 (57.2%). The women who died were mainly nulliparous (34.1%) in 2019 and multiparous (41.8%) in 2020. Table 2 shows the distribution of maternal deaths by parity in 2019 and 2020.

- Abortion

The majority of women who died had no history of abortion (73.6%) in 2019 and (74.2%) in 2020. Table XI illustrates the frequency of abortions among women who died in 2019 and 2020.

Clinical characteristics

- Prenatal consultations

The proportion of women for whom the number of prenatal consultations (PNCs) is known was 88.1% in 2019 and 85.9% in 2020. The number of PNCs performed was mostly between one and three (71.6% in 2019 and 67.1% in 2020). Figure 3 illustrates the distribution of women who died in 2019 and 2020 according to the number of PNCs.

- Outcome of pregnancy

The pregnancies of women who died had reached full term in 63.5% of cases in 2019 and 71.4% of cases in 2020. Table 2 illustrates the distribution of pregnancy outcomes for women who died in 2019 and 2020.

- Place of delivery

In 2019, 131 patients who died (60.9%) had given birth in a public health facility (EPS), while in 2020 the number was 180 patients (65%). Table 3 shows the place of delivery for women who died in 2019 and 2020.

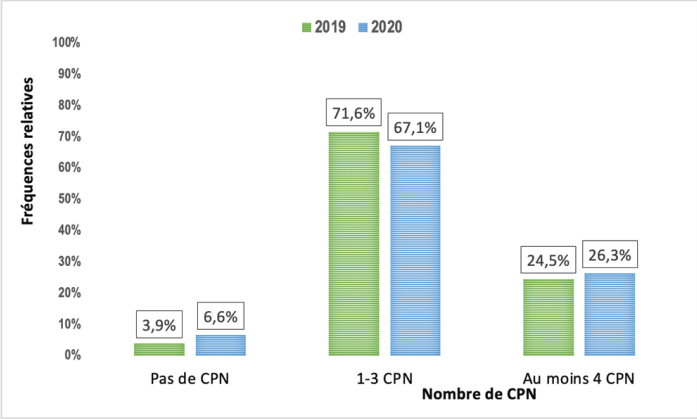

Figure 3: Distribution of women who died in 2019 and 2020 according to the number of prenatal care visits.

Table 2: Pregnancy outcome of women who died in 2019 and 2020.

Pregnancy outcome	2019 n		2020 n (%)	
Full-term delivery	**115**	**(63.5)**	**167**	**(71.4)**
Premature delivery	61	(33.7)	57	(24.4)
Ectopic pregnancy	4	(2.2)	4	(1.7)
Abortion	1	(0.6)	6	(2.6)

Table 3: Place of delivery for women who died in 2019 and 2020.

Place of delivery	2019 n		2020 n	
EPS	**131**	**(60.9)**	**180**	**(65.0)**
Health station	38	(17.7)	31	(11.2)
Health center	27	(12.6)	35	(12.6)
At home	10	(4.7)	15	(5.4)
Not specified	8	(3.7)	10	(3.6)
Health center	1	(0.5)	2	(0.7)
Private healthcare facility	0	(0.0)	4	(1.4)

- Referral during childbirth

In 2019, 92 patients who died (48.9%) had been referred to a higher-level facility, compared with 96 patients who died (51.1%) in 2020.

- Mode of delivery

In 2019, 100 patients who died (49.8%) had given birth by cesarean section; this number rose to 139 patients who died (51.1%) in 2020. Table 4 shows the distribution of women who died in 2019 and 2020 according to mode of delivery.

- Outcome of the newborn

In 2019, there were 125 newborns from deceased mothers (56.3%) who survived, while in 2020, there were 142 (52%). Table 5 shows the distribution of the fate of newborns of women who died in 2019 and 2020.

- Working hours

The average working hours were 7.2 hours ± 4.3 hours in 2019 and 6.9 hours ± 5.3 hours in 2020. Table 6 shows the distribution of descriptive parameters for the working hours of women who died in 2019 and 2020.

Table 4: Distribution of women who died in 2019 and 2020 according to mode of delivery.

Mode of delivery	2019 n		2020 n	
Cesarean	**100**	**(49.8)**	**139**	**(51.1)**
Natural vaginal delivery	91	(45.3)	122	(44.9)
Instrumental low pathway	10	(5.0)	11	(4.0)

Table 5: Distribution of the fate of newborns of women who died in 2019 and 2020.

	2019 n (%)		2020 n	
Alive	**125**	**(56.3)**	**142**	**(52.0)**
Stillborn fresh	59	(26.6)	86	(31.5)
Macerated stillbirth	11	(5.0)	17	(6.2)
Unknown or unspecified	27	(12.2)	28	(10.3)

- Circumstances and causes of maternal deaths

Most deaths occurred in health facilities (73.4% in 2019 and 75.2% in 2020) and in urban areas (93.3% in 2019 and 92.4% in 2020). The main causes of death were hemorrhage (32.1% in 2019 and 37.2% in 2020) and high blood pressure and its complications (28.7% in 2019 and 22.7% in 2020). Table 6 shows the circumstances and causes of death.

Table 6: Circumstances and causes of maternal deaths in 2019 and 2020.

Circumstances of death	2019 n (%)	2020 n
Place of death		
Public health facility	193 (73.4)	243 (75.2)
Health center	30 (11.4)	39 (12.1)
On the way to the health facility	20 (7.6)	6 (1.9)
Health center	9 (3.4)	16 (5.0)
Health hut	5 (1.9)	3 (0.9)
At home	5 (1.9)	14 (4.3)
Private healthcare facility	1 (0.4)	2 (0.6)
Place of death		
Urban	235 (93.3)	302 (92.4)
Rural	17 (6.7)	25 (7.6)
Cause of death		
Hemorrhage	85 (32.1)	123 (37.2)
Hypertension and complications	76 (28.7)	75 (22.7)
Other causes	52 (19.6)	43 (13.0)
Anemia	16 (6.0)	43 (13.0)
Unknown	16 (6.0)	24 (7.3)
Infection	14 (5.3)	15 (4.5)
Abortion	2 (0.8)	2 (0.6)
Dystocia	2 (0.8)	6 (1.8)
Malaria	1 (0.4)	0 (0.0)
HIV infection	1 (0.4)	0 (0.0)

The majority of maternal deaths occurred in the immediate postpartum period, accounting for 48.9% in 2019 and 54.8% in 2020. Figure 15 shows the distribution of maternal deaths in 2019 and 2020 according to the time of death.

Discussion

This is a large-scale retrospective study with three-phase cluster sampling. For this reason, we were unable to obtain the exact number of maternal deaths in Senegal or live births for the same period. Therefore, the MMR could not be calculated. Given that most studies on the subject used the MMR, it was difficult to use the pre-existing data.

During our study, the availability of maternal death notification forms for 2019 was 40.0% (682 forms expected versus 273 available). This proportion was 42.7% for 2020 forms (797 forms expected versus 340 available). The medical regions of Kaffrine, Kédougou, and Thiès had more forms than expected for 2019. For 2020, no maternal death notification forms were available in the medical regions of Fatick and Louga. The regions of Kaffrine and Thiès had the highest availability of death notification forms for 2020. The low levels of form availability are attributable to data loss due to difficulties in archiving the forms, but also to multiple channels for transmitting the forms.

During our study, the average age of women who died was 28.4 ± 6.9 in 2019 and 28.9 ± 7.2 in 2020. The most represented age group was 25-35 years old, with 47.1% in 2019 and 43.1% in 2020, with extremes of 13-46 years old in 2019 and 14-48 years old in 2020. We noted that the age characteristics of deceased patients did not change statistically between 2019 and 2020. In the sub-region, in Cameroon by Foumane [12], the age range was comparable to that of our study (25-34 years). In Gabon, according to Mayi-Tsonga [13], the average age was slightly lower (25 years) with relatively similar extremes (16 and 41 years). In Madagascar [14], on the other hand, the average age was higher (31 years) with extremes of 15 and 63 years.

In France, however [15], the most represented age group was those over 35, accounting for 40% of deaths.
Contrary to most studies showing that advanced age and extreme youth could increase the risk of maternal mortality [16,17], we found that in our region, the most represented age group and average age were those in the middle, which could be explained by the higher rate of pregnancy at these ages in our countries, unlike in developed countries where pregnancies occur later in life.

The number of patients with at least one medical history accounted for no more than a quarter of the patients who died. These medical histories were diabetes, with 27.3% in 2019 and 24.3% in 2020; hypertension, with 23.7% in 2019 and 18.9% in 2020; and malaria, which was less common, with 1.1% and 3.3% in 2019 and 2020, respectively.

In an American study examining the relationship between comorbidity and severe obstetric complications, it was reported that comorbidity increased the risk of severe obstetric complications by a factor of three, whereas in our study, the majority of those who died had no comorbidity. We can therefore observe that although the presence of comorbidities played an important role in the factors contributing to death, it was much less significant than in developed countries [18].

The majority of women who died were multiparous, with nearly half (49.6% and 42.8% in 2019 and 2020, respectively). This proportion increased with the number of pregnancies, which could be explained by the fragility of the uterus, which can increase the occurrence of complications.

The majority of deaths occurred among nulliparous women in 2019 (34.1%), followed by multiparous women (20.7%), while in 2020 multiparous women were more affected, which is somewhat contradictory but consistent with Foumane's 2019 study in Cameroon [12], where nulliparous women accounted for a larger proportion of deaths, while in Burkina Faso and Niger, primiparous women were in the majority.

This could be explained by complications due to the lack of experience of the women in labor.

The majority of patients who died (73.6% in 2019 and 74.2% in 2020) had no history of abortion.

For proper pregnancy monitoring, the WHO recommends at least four antenatal care visits. In our study, 75.5% of patients had fewer than four antenatal care visits (including 3.9% with zero visits and 71.6% with one to three visits) and 24.5% had at least four antenatal care visits in 2019, with comparable results for 2020. Our results are similar to those of other developing countries [19].

The low number of antenatal care visits could also be explained, apart from accessibility to centers, by low socioeconomic status, as this plays an important role in maternal morbidity and mortality [19,20].

The majority of patients who died had carried their pregnancies to term (63.5% in 2019 and 71.4% in 2020), followed by those who had given birth prematurely (33.7% in 2019 and 24.4% in 2020); 2.2% in 2019 and 1.7% in 2020 had had an ectopic pregnancy, and finally 0.6% in 2019 and 1.6% in 2020 had had an abortion. This shows a low rate of pregnancy complications.

In our study, the majority of patients who died had given birth in a public health facility (60.9% in 2019 and 65% in 2020); In descending order of importance in terms of the number of deaths, health posts came second in 2019 and health huts in 2020, with 17.7% and 12.6% respectively, followed by health centers in 2019 and health posts in 2020, with 12.6% and 11.2% respectively. Deaths at home ranked fourth, with 4.7% in 2019 and 5.4% in 2020.
In general, we found that the number of deaths increases as we move up the healthcare pyramid, which could be explained by the fact that patients experiencing complications are usually referred to EPS.

In our study, 48.9% of patients who died were referred in 2019 and 59% in 2020. Our 2019 referral rate was lower than that of all the studies conducted in West Africa, which were more comparable to the 2020 rate, i.e., above 50% [21,22]. However, our results were lower than those reported by Fomulu in Cameroon (82.05%). We can say in general that evacuations play a significant role in the profile of maternal deaths in sub-Saharan Africa [21,23,25]. This association between maternal mortality and obstetric referrals has already been reported by several authors who, in studies on morbidity and mortality related to obstetric transfers, noted more maternal deaths among evacuated women [26,27].

This could be explained by a tendency to refer patients to more accessible facilities that do not have the technical resources necessary to manage certain complications.

The main mode of delivery for our series of deceased pregnant women was cesarean section, accounting for 49.8% in 2019 and 51.1% in 2020. These results are comparable to those in The Gambia [28].

This could be explained by the fact that most obstetric complications require a cesarean section.

Another lesson we can learn from the results of our study is that cesarean sections, despite their high rate, did not save the lives of these women in labor. Cesarean section is indeed a procedure that can interrupt a process that could inevitably lead to a fatal complication; however, when the complication has already set in, delivery by cesarean section will most often need to be combined with resuscitation in order to be effective.

The majority of newborns were alive (50.3% in 2019 and 52% in 2020), but the death rate was still high, at over 30% in both years. The majority of live newborns were male, although the difference was not significant (in 2019, 51.3% were boys and 45.1% were girls, with similar figures for 2020).

It should be noted that the rate of patients who died in an EPS is more than 10% higher than that of patients who gave birth in an EPS. In 2019, 60.9% of women gave birth in a public health center, compared to 73.4% who died in the same facilities, while in 2020 these rates were 65% and 75.2% respectively.

This could be explained by postpartum referrals and complications. The direct causes were dominated by hemorrhages, accounting for 32.1% in 2019 and increasing to 37.2% in 2020, followed by hypertensive disorders and their complications (HRP-preeclampsia/eclampsia). These same results are found in the subregions [13,28,29].

We can understand here that the fight against maternal mortality will necessarily require the establishment of sufficient quantities and quality of resuscitation units, as well as the availability of labile blood products close tothese reference structures.

Indirect causes of mortality accounted for nearly 10% of patient deaths, with anemia (6%) followed by infectious causes (5.6%) at the top of the list, increasing the need for blood products and personnel to manage these causes.

Nearly half of the patients (48.9% in 2019 and 54.8% in 2020) died in the immediate postpartum period. This highlights the need for resuscitation services in maternity wards to directly manage complications arising from childbirth.

Conclusion

The results of our study show that the typical profile of maternal death was a woman aged 25-35, multigravida and nulliparous with no history of abortion, who had undergone at least one antenatal care visit, who died after referral to a public health facility, less than 48 hours after a cesarean section, as a result of hemorrhage, hypertension, or complications while giving birth to a live male infant.

This typical profile highlights flaws in the healthcare system:

- A young multigravida woman (lack of family planning).
- At least one antenatal care visit versus cesarean section, hemorrhage, hypertension (lack of preparation for childbirth and management of intercurrent diseases).
- Dies after referral to a public health facility (weak technical capabilities of local facilities).

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