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Maternal Hospital Mortality in Cotonou: Incidence, Care-Associated Adverse Events and Causes

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Abstract

Introduction: Despite the many efforts made to combat preventable maternal deaths, these still remain high in Benin. It was therefore important to revisit the causes but especially the adverse events associated with care (EIS) in maternity. **Objective**: Determine the incidence, adverse events associated with care and causes of intra hospital maternal mortality in cotonou. **Methods**: This was a cross-sectional maternal mortality review study with retrospective data collection. It covered all cases of maternal death recorded between 2017 and 2021 in two (2) reference university maternities in Cotonou. Adverse events associated with care and the patient were analyzed using the maternal death audit grid validated for Benin. SPSS.26 software was used for data analysis. **Results:** The in-hospital maternal mortality ratio in Cotonou was 2028 maternal deaths per 100,000 live births in 2021. Only 7.2% (n = 36) of deaths were audited. The deceased mothers were 29.8 ± 7.4 years old, with no fixed monthly income in 82.7% (n = 420). Serious adverse events associated with care were: delay in decision to refer in 37% (n = 188), non-medical referral in 85.8% (n = 436) of cases, inadequate pre-referral treatment in 25.7% of cases. In receiving maternities, delay in diagnosis and inappropriate treatment at the receiving maternity were noted respectively in 22.9% and 28.6% of cases of maternal death. The direct causes of maternal death were dominated by serious obstetric hemorrhage in 43.9% (n = 223). As for the indirect causes, they were dominated by anemia excluding obstetric hemorrhages in 21.5% (n = 109). **Conclusion**: The in-hospital maternal mortality ratio was very high in Cotonou. The main cause was severe obstetric hemorrhage. There were sev-

eral serious healthcare-associated adverse events whose correct management would significantly reduce the incidence of maternal deaths.

Keywords

Maternal Mortality, Adverse Events, Care, Cotonou

1. Introduction

Maternal mortality is the death of a woman occurring during pregnancy or within 42 days of its termination, regardless of duration and location, for any cause determined or aggravated by pregnancy or care that it motivated, but neither accidental nor fortuitous [1]. According to the 5th demographic health survey in Benin 2017-2018 (EDSB), the maternal mortality ratio (RMM) was 391 deaths per hundred thousand live births [2]. This is one of the highest maternal death ratios in the world in general and in sub-Saharan Africa in particular. To deal with this, Benin is committed to achieving the Sustainable Development Goals (SDGs) which stipulate in point 3.1 that by 2030, the maternal mortality rate should fall below the threshold of 70 per 100.000 live births [3].

To achieve this ambitious goal, Benin must learn from each case of death and avoid a new maternal death through the recurrence of insufficient care. The three delays contribute to the high incidence of these maternal deaths [4]. The first delay reflects the slowness of decision-making to get to the health center; it is supported by the ignorance of the signs of danger, the traditional treatment and the absence of autonomy of the woman. The second delay reflects transportation and/or environmental difficulties; it is supported by the lack of means of transport, communication and the defect of the roads and tracks of rural desert. The third delay reflects the diligence of the provision of care in health facilities; it is supported by the absence of competent personnel, the lack of organisation, the absence of a protocol, the delays or lack of diagnosis or treatment. Each of these delays is the site of risk-bearing events and serious adverse events. The fight against maternal deaths is based on the prevention and correct management of serious adverse events associated with care (SAE). These correspond to non-optimal treatments with serious and unexpected consequences [5]. According to the WHO, a serious adverse event associated with care is an unexpected situation of sudden onset resulting in hospitalization or prolongation of hospitalization, permanent incapacity or disability, congenital anomaly, vital risk or even death [6]. Risk-bearing events are situations or factors that contributed to the occurrence of the event associated with care [7].

This work aims to revisit the causes of maternal death but especially the adverse events associated with care (EIS) at maternity in Cotonou in 2023.

2. Methods

This was a cross-sectional review-type study of maternal mortality with retros-

pective data collection. It covered all cases of maternal death recorded between 2017 and 2021 at the maternity hospital of the Center Hospitalier and Universitaire de la Mère et de l'Enfant Lagune (CHU-MEL) and the University Clinic of Obstetrics Gynecology (CUGO) of the National Center Hospital and University of Hubert Koutoukou MAGA (CNHU-HKM), two (2) reference maternities in the city of Cotonou in the Republic of Benin. Included in the study were cases of maternal death according to the WHO definition [1]. This was a comprehensive census sampling of maternal deaths. The variables studied were: 1) sociodemographic (age, profession); 2) the reference; 3) serious adverse events associated with care and risk-bearing events 4) direct causes (haemorrhages, abortions, blood pressure disorders, dystocia, infections) and indirect causes (anaemia, malaria, HIV/AIDS, etc.)). The analysis of the files was made thanks to a counting sheet elaborated from the defined variables. Serious adverse events associated with care and risk carriers were identified through the analysis of maternal death records based on the maternal death audit grid validated by the Benin Ministry of Health. SPSS.26 software was used for data analysis.

The "no name" "no blame" maternal mortality review principles were adhered to. The rules of ethics and medical ethics in research, in particular the anonymity of information, have been observed.

Limits of the Study

The objective of this study was to determine the epidemiological characteristics of intra-hospital maternal mortality in Cotonou between 2017 and 2021.

A total of 508 maternal deaths were analysed out of 709 recorded for the period. The retrospective nature of this study includes missing records or missing information. However, given the study size (n = 508), these missing records or missing information did not have a major impact on the quality of this study in terms of incidence and epidemiological characteristics but did not guarantee the completeness of serious adverse events associated with care.

3. Results

Of the 508 cases of maternal deaths studied in the two maternity hospitals, only 36 cases (7.1%) were audited, including 35 cases at CHU-MEL and 01 cases at CUGO. For analytical reasons, only maternal death audits carried out at the CHU-MEL were studied.

3.1. Maternal Mortality Ratio (MMR)

During the study period, 709 maternal deaths were recorded in the two reference maternities for 34,944 live births. That is a maternal mortality ratio of 2028 per 100,000 live births. At the CHU-MEL, the MMR was 1046 deaths per 100,000 live births compared to 4000 deaths per 100,000 live births at the CUGO, *i.e.* 5.6 times higher as shown by **Figure 1**.

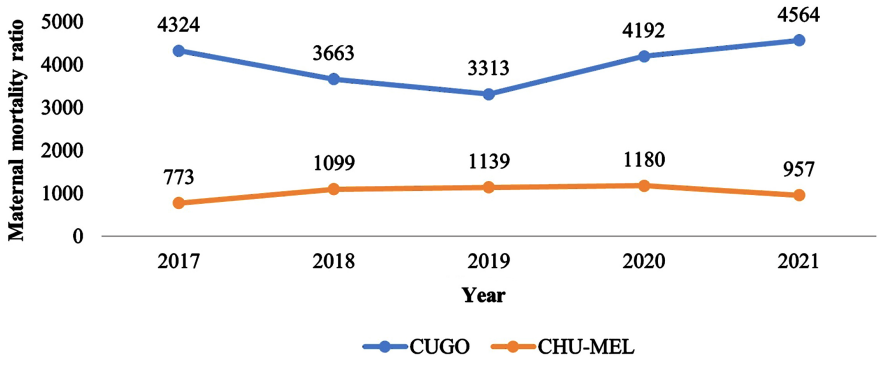

Figure 1. Evolution of the maternel mortality ration in CHUMEL and CUGO maternity units from 2017 to 2021.

3.2. Sociodemographic Characteristics

During the period of the study, 508 cases of maternal death were analyzed in the two maternities.

The average age of the deceased mothers was 29.8 years ± 7.4 years; the median was 30 years with the extremes of 14 and 52 years.

In 82.7% (n = 420) of the cases, the deceased mothers had an occupation without a fixed monthly income.

3.3. Reference

Deceased mothers were referred from peripheral centers in the suburbs of Cotonou and other departments in 82.9% (n = 421) of cases and in 15.4% (n = 78) of cases they were admitted themselves. The mode of admission was not provided for 1.8% (n = 9) of cases of maternal death.

Referral was made without ambulance in 85.8% (n = 436) and with ambulance in 14.1% (n = 72) of cases.

3.4. Adverse Events Revealed by the Death Audit

Out of 709 cases of maternal death, only 35 cases were audited at the CHU-MEL throughout the study period, *i.e.* a completion rate of 7.2% (Table 1).

Serious adverse events leading to maternal death were related to the patient, her family and the community and to the referral system, including referral and reception health centers such as CHUMEL. Among these groups of serious adverse events those related to the health care system are much greater with delay in reference and absence of pre-reference treatment in 65.7% and diagnostic and treatment problems in 85.7% of cases of maternal death.

These serious adverse events were mostly driven by the risk events presented in Table 2 below. These serious adverse events were mostly driven by the risk events presented in Table 2 below.

Risky events associated with care were related to the patient, her family and the community, and to the system of care, including care delivery services and hospital administration. Among all these groups, risky events were much more

Table 1. Distribution of serious adverse events associated with care revealed in the audit of maternal deaths at the CHU-MEL in Cotonou between 2017 and 2021.

	Effective (n = 35)	Frequency (%)
Related of patients/family/communauty		
Refus du traitement ou de la référence	3	8.6
Refusal of consultation in the center	2	5.7
Transportation difficulty	2	5.7
Failure to fulfill the prescription	1	2.9
Related to the center having referred		
Referral decision delay	13	37.1
Lack of medicalization of the reference	10	28.6
Inadequate pré-reference processing	9	25.7
Related of center (CHU-MEL)		
Incomplete initial assessment	11	31.4
Incorrect diagnosis	8	22.9
Treatment not carried out	11	31.4
Inappropriate treatment	10	28.6
Lack of supervision	5	14.3
Partograph filling defect	1	2.9

Table 2. Distribution of vents carrying risks of maternal death occurring at CHUMEL in Cotonou between 2017 and 2021.

	Effective (n = 35)	Frequency (%)
Patients/Family/communauty		
Low financial capacity	11	31.4
Ignoring/belief	1	2.9
Insufficient information of patients/communauty	8	22.9
Insufficiency prenatal	8	22.9
Nursing staff		
Lack of organization of medical transport	15	42.9
Lack of Knowledge	19	54.3
Lack of service organization	10	28.6
Hospital administration		
Lack of blood products	9	25.7
Lack of qualified agents	5	14.3
Lack of consumables	7	20

frequent at the level of care provision services, led by poor knowledge of professionals in a proportion of 54.3%.

Maternal causes of death

Maternal causes of death were direct and indirect listed in Table 3 below.

Obstetric haemorrhage occupied the first place with 44.5 of deaths followed by hypertensive disorders, infection and complication of abortions respectievely in 44.5%, 23.1%, 5.3% and 2.8%.

Indirect causes of maternal deaths were noted for 28.3% of deaths and anemia was the most common etiology, 21.5% of cases.

4. Discussion

4.1. In-Hospital Maternal Mortality Ratio

In Cotonou between 2017 and 2022, intra-hospital maternal mortality was 2028

Table 3. Distribution of cases according to causes of maternal death at CUGO and CH-MEL from 2017 to 2021.

	Effective (n = 508)	Frequency (%)
Direct obstetric directes		
Obstétric hemorrhage and its complications		
Hemorrhages due to ectopic pregnancy	3	0.6
Antepartum hemorrhage	47	9.3
Postpartum hemorrhafe	176	34.6
High blood pressure during pregnancy and complications		
Preéclampsia/eclampsia	101	19.9
High blood pressure during pregnancy	7	1.4
Fœtal death in utero in preeclampsia	9	1.8
Puerperalesinfections		
Postpartum endometritis end parametritis	23	4.5
Postpartum pertonitis	4	0.8
Abortion and complications	11	2.2
Indirect causes		
Anemia	109	21.5
Sickle cell disease	9	1.8
HIV	5	1.0
Renal failure, diabetic nephropathy	6	1.2
Pneumonia/asthma	5	1.0
Heart failure	3	0.6
*Others	7	1.4

* = Severe malaria, breast cancer, epilepsy, leukemia.

maternal deaths per hundred thousand live births. This rate was much higher at the CUGO (4000 deaths/one hundred thousand live births) than at the CHU-MEL (1046 deaths/one hundred thousand live births) in Cotonou. This disparity could be explained by the fact that the CHU-MEL maternity hospital offers more favorable financial accessibility than the CUGO. This means that early first-line recourse to the CHU-MEL maternity unit is observed. These two parameters (early recourse, first intention) in the event of referral for obstetric emergencies would explain the high rate of deliveries with a low intra-hospital maternal mortality ratio (MMR) at the CHU-MEL as opposed to the high rate of intra-hospital MMR at the Cotonou CUGO. Also, the CUGO is hosted by the very first National Hospital and University Center (CNHU) in Benin, which has the largest intensive care unit in Benin. This cohabitation makes the CUGO the maternity hospital that receives more hopeless cases and prognosis reserved in Cotonou because of its proximity to the largest intensive care unit. Also, failure to carry out maternal death audits throughout the 2017-2021 period could promote the recurrence of certain serious adverse events associated with care

It emerges from the analysis of the RMMs in the two reference hospitals of Cotonou, that financial accessibility, the precocity of reference improve the RMMs and the cohabitation with the largest reference service and the non-performance of maternal death audits aggravate the RMM. The latter in the national reference maternities of Cotonou was 5.2 times higher than in the population. Indeed, according to the 2017-2018 DHS, the MMR was 391 deaths per 100,000 NV [2]. These two maternities alone account for a significant proportion of maternal deaths. In Nigeria in 2007, in a rural tertiary level hospital an MMR of 2232/100,000 live births was recorded over a 10 year period [8].

The MMR was 19 times higher in our series than in area hospitals in the Democratic Republic of Congo (DRC) compared to data from the series by Jean-Bosco Kahindo Mbeva *et al.* in 2018 which had found 106.9 per 100,000 live births (LV) as intra-hospital RMM in their area hospitals. This sharp rise in the intra-hospital mortality rate in Cotonou could be explained by the fact that the CHU-MEL and the CUGO in Cotonou are level 3 maternity units and as such, they receive the most serious cases from these hospitals of areas that do not have the necessary skills. [9] At the Tigray Hospital in northern Ethiopia, the MMR was respectively 412 per 100,000 NV according to the survey by Teka H *et al.* in 2028 and 469 per 100,000 live births in 2018 and 2019 [10] [11]. This rate remains lower than that of our series. This observation has its source in the definition of the variables, the duration and the framework of the study.

In Nigeria in 2019, in Benin City Central Hospital, the MMR was 395 maternal deaths per 100,000 NV [12].

4.2. Occupational Characteristics of Victims

The average age of deceased mothers was 29.8 years ± 7.4 years with a median of 30 years.

These results are similar to those of Olamijulo JA *et al.* who had found an average age of 30.8 ± 5.9 years [13], economically weak with 82.4% (n = 420) without a fixed monthly income as in the series by Vincent and al in Morocco in 2016 [14]. Conditions such as: low socio-economic level, unfavorable. This profile corresponds to that of women with economic conditions, the high cost of health care and the absence of adequate social security in Benin are unfavorable to the fight against death maternal. [2]

4.3. Reference/Counter Reference

The reference was the mode of admission for the majority (82.9%) of deceased mothers. The studies conducted by Saizonou *et al.* (74%) in seven reference hospitals in the south of Benin had already attracted attention in 2008 [15]. In India in 2012, P. Roopa *et al.* noted that 86.9% of deceased mothers were referred. [16]. In Ghana in 2012 G. Ganyaglo *et al.* and S. Gumanga *et al.* found 51.3% and 41.7% respectively [17] [18]. The reference is the source of maternal deaths in most series. It is important to analyze the reference conditions in our hospitals in order to identify adverse events or risky situations.

4.4. Serious Adverse Events Associated with Treatment

4.4.1. Reference Decision Delay

In our series, in 37.1% of cases of maternal death, the decision to evacuate was taken late in the health facility that provided the referral. The root causes or risk-bearing events were: ignorance of patients in 2.9% of cases, refusal of treatment or referral in 5.7% of cases of death, delay in consultation at the referral center in 5.7% of cases, insufficient information/knowledge of patients or the community in 22.9% of death cases, low financial capacity observed in 31.4% of deceased mothers, lack of knowledge and/or competence of the caregiver. Jean-Bosco Kahindo Mbeva *et al.* in the DRC had observed in their series 12.3% decision delay in his series. [9] Raising community awareness, training health workers on the referral and counter-referral system could reduce the MMR in our country.

4.4.2. Inadequacy of the Pre-Reference Treatment

In 25.7% of cases of maternal death, the pre-referral treatment was inadequate. Several risk-bearing events could be noted. These were: defective consumables in 14.3% of cases, defective blood products and derivatives in 25.7% of cases and lack of knowledge and/or skill of agents in 54.3% of cases. Also the fear of risk events related to the patient was: refusal of referral or care in 8.6% of cases and low financial capacity in 31.4% of cases.

4.4.3. Lack of Medicalization of the Reference for Obstetric Emergencies

Medical transport is the most secure for patients in a health emergency. It includes the use of the ambulance and medical personnel on board. It offers comfort, security and quick access to the reception maternity ward. Any other means

will cause delay and/or aggravate the clinical condition of the patient. This is the case in our series where 85.8% (n = 436) of deceased mothers were referred without an ambulance and 28.6% of deceased mothers referred by ambulance did not have health personnel on board. These difficulties can be explained by a lack of organization of the service in 28.6% of cases of maternal death, a low financial capacity observed in 31.4% of deceased mothers and above all a problem of organization of medical transport at the level health centers in 42.9% of deceased mothers. Better organization of ambulance transport with a third-party payment system could reduce maternal mortality in Benin. Indeed, according to Hagos Godefay *et al.*, pregnancy-related mortality in districts with higher than average ambulance use was 149 per 100,000 live births (95% confidence interval, CI 77 - 260), versus 350 per 100,000 (95% CI 249 - 479) for below-average use (P = 0.01). [19]

4.4.4. Processing Failure

In our series, the treatment was carried out late in 31.4% of cases of maternal death and was inadequate in 28.6% of cases. This delay is mainly attributable to the unavailability of medical inputs and consumables and the low economic power of the victims. Jean-Bosco Kahindo Mbeva *et al.* in the DRC in 2018 had observed that 48.6% of maternal deaths were noted in the delayed therapeutic decision subgroup and in 83.1% of cases of maternal death, the treatment was inadequate [9].

4.4.5. Monitoring Fault

Monitoring includes a clinical and paraclinical examination of the patient. The defect concerns one or the other of the components or both. In our series, 14.3% insufficient surveillance was recorded among cases of maternal death. Several risk-bearing events could be identified. This is a lack of knowledge and skill of the nursing staff, the small number of nursing staff and the low power of the patient for the paraclinical monitoring assessment. Jean-Bosco Kahindo Mbeva *et al.* in the DRC in 2018 had observed 65.4% of maternal deaths in the subgroup of those who had inadequate surveillance [9].

4.4.6. Causes of Death

Mothers who died of direct obstetric causes accounted for 75.6% of cases in our series. A lower rate (66%) was reported by Wane D. *et al.* [20] in Senegal in 2012. The main direct cause of maternal death during our study was haemorrhage (43.9%). Horo A. had found a similar percentage of 44% in Ivory Coast in 2008 [21].

In our series, the direct obstetric causes were mainly haemorrhages in 44.5%) followed by hypertensive disorders, infections and abortion complications respectively in 44.5%, 23.1%, 5.3% and 2.8%. G O Igberase, P N Ebeigbe found at the Niger Delta referral hospital in 2007 in order puerperal sepsis, complications of abortion, preeclampsia/eclampsia, prolonged obstructed labor, haemorrhage representing respectively 33%, 22.6%, 17.4%, 13.0% and 7.8%. This is a rural

hospital, unlike our national reference hospitals in Cotonou, which receive all cases from all regions [8].

According to Bajaj K. Parturients who have a blood transfusion, sepsis or pulmonary edema are at higher risk of death [22].

5. Conclusion

The maternal hospital mortality rate was very high in the national reference university maternity hospitals in Cotonou, Benin. This maternal mortality could be explained by the low rate of completion of maternal death audits and implementation of recommendations. This situation has its roots in the ongoing health reforms. The few maternal death audit cases conducted noted the existence of numerous serious adverse events associated with care and associated risk events. Reducing the rate of maternal deaths requires systematic analysis of deaths and automatic implementation of recommendations by health professionals committed to the cause.

Contributors

The authors contributed to all the steps leading up to this article namely: initiation, collection, data analysis, article writing, critical review of the content and final approval of the version to be published.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] World Health Organization (2019) Eleventh Revision of the International Classification of Diseases. https://apps.who.int/gb/ebwha/pdf_files/WHA72/A72_29-fr.pdf

[2] National Institute of Statistics and Economic Analysis (INSAE) (2019) Demographic and Health Survey in Benin, 2017-2018. INSAE and ICF, Cotonou and Rockville, 317.

[3] World Health Organization (2015) Report of the Secretariat of the 138th Session of the Executive Board on health in the Sustainable Development Agenda. https://apps.who.int/gb:ebwha/pdf_files/EB138/14

[4] Issiakia, S., Ziemlè, C.M., Savadogo, L.B.G., Somé, D.T., Bamouni, S.F., Dadjoari, M., Sawadogo, R.W. and Sanon-Ouedraogo, D. (2018) Is the Fight against Maternal Mortality in Burkina Faso Suitable for Reducing the Three Delays? *Public Health*, **30**, 273-282.

[5] Moll, M.C. and Bart, S. (2020) Adverse Events Associated with Care, What You Need to Know. *Advances in Urology-CME*, **4**, 126-130.

[6] High Authority for Health (2021) Adverse Event Associated with Treatment. The Healthcare Team Would Like to Hear Your Testimony. https://www.has-sante.fr/upload/docs/application/pdf/2021-10/fiche_information_patients

[7] High Authority for Health (2015) Root Causes of Risk Events. The HAS Is Mobilizing to Reduce the Risks Associated with Treatments.

https://www.has-sante.fr/jcms/c_2035903/fr

[8] Igberase, G.O. and Ebeigbe, P.N. (2007) Maternal Mortality in a Rural Referral Hospital in the Niger Delta, Nigeria. *Journal of Obstetrics and Gynaecology*, **27**, 275-278. https://doi.org/10.1080/01443610701213687

[9] Karemere, J.B.K.M.H., Mitangala, N.P., Nyavanda, L. and W'Itende, J.P.M. (2018) Explanatory Factors of Maternal Deaths in Hospitals: A Study at the Level of Six Health Zones in the East of the Democratic Republic of Congo. *International Journal of Innovation and Applied Studies*, **4**, 559-568.

[10] Teka, H. and Zelelow, Y.B. (2018) A 3 Years Review of Maternal Death and Associated Factors at Ayder Comprehensive Specialized Hospital, Northern Ethiopia. *Ethiopian Journal of Reproductive Health*, **10**, 38–45.

[11] Teka, H., Yemane, A., Zelelow, Y.B., Tadesse, H. and Hagos, H. (2022) Maternal Near-Miss and Mortality in a Teaching Hospital in Tigray Region, Northern Ethiopia. *Women's Health*, **18**, 1-11. https://doi.org/10.1177/17455057221078739

[12] Aikpitanyi, J., Ohenhen, V., Ugbodaga, P., Ojemhen, B., Omo-Omorodion, B.I., Ntoimo, L.F., Imongan, W., Balogun, J.A. and Okonofua, F.E. (2019) Maternal Death Review and Surveillance: The Case of Central Hospital, Benin City, Nigeria. *PLOS One*, **14**, e0226075. https://doi.org/10.1371/journal.pone.0226075

[13] Olamijulo, J.A., Olorunfemi, G. and Okunola, H. (2022) Trends and Causes of Maternal Death at the Lagos University Teaching Hospital, Lagos, Nigeria (2007-2019). *BMC Pregnancy Childbirth*, **22**, Article No. 360. https://doi.org/10.1186/s12884-022-04649-4

[14] Vincent, B., Amina, E., Choukri, E. and Noufissa, Z. (2016) Confidential Survey of Maternal Deaths in 2015 in the Six Priority Regions in Morocco. Rabat: Ministry of Health: Directorate of Health and Ambulatory Care. 1-67. https://vdocuments.mx/enqute-confidentielle-sur-les-dcs-maternels-de-2015-.html

[15] Saizonou, J., Brouwere, V., De Dramaix-wilmet, M., Buekens, P. and Dujardin, B. (2006) Audit of the Quality of Management of Small Escapes. *Scientific Research*, **16**, 33-42.

[16] Roopa, P.S., Verma, S., Rai, L., *et al.* (2013) "Near Miss" Obstetric Events and Maternal Deaths in a Tertiary Care Hospital: An Audit. *Journal of Pregnancy*, **2013**, Article ID: 393758. https://doi.org/10.1155/2013/393758

[17] Ganyaglo, G.Y.K. and Hill, WC. (2012) A 6-Year (2004-2009) Review of Maternal Mortality at the Eastern Regional Hospital, Koforidua, Ghana. *Seminars in Perinatology*, **36**, 79-83. https://doi.org/10.1053/j.semperi.2011.09.015

[18] Gumanga, S.K., Kolbila, D.Z., Gandau, B.B.N., *et al.* (2011) Trends in Maternal Mortality in Tamale Teaching Hospital Ghana. *Ghana Medical Journal*, **45**, 105-110.

[19] Godefay, H., Kinsman, J., Admasu, K. and Byass, P. (2016) Can Innovative ambulance Transport Prevent Pregnancy-Related Deaths? One-Year Operational Assessment in Ethiopia. *Journal of Global Health*, **6**, Article ID: 010410. https://doi.org/10.7189/jogh.06.010410

[20] Wane, D., Alford, S., *et al.* (2012) Maternal and Newborn Health in Senegal: Successes and Challenges. Ministry of Health, Dakar, 1-70.

[21] Horo, A., Mohamed F., Adjoussou, S. and Kone, M. (2008) Dysfunction and Maternal Mortality. Analysis of 35 Cases at the Maternity Hospital of Yopougon University Hospital (Abidjan, Ivory Coast). *Médecine d'Afrique Noire*, **55**, 449-453.

[22] Bajaj, K., de Roche, A. and Goffman D. (2021) The Contribution of Diagnostic Errors to Maternal Morbidity and Mortality during and Immediately after Childbirth: State of the Science. Agency for Healthcare Research and Quality, Rockville.