

Assessment of pre-eclampsia and eclampsia health commodities' supply chains in selected hospitals of Lagos State during COVID-19 pandemic

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Abstract

Purpose – Pre-eclampsia and eclampsia (PE/E) are rising in Sub-Saharan Africa, including Nigeria. This study aims to evaluate the availability and logistics management of sixteen items from the Nigerian essential medicine list required for managing these conditions.

Design/Methodology/approach – A cross-sectional study in 50 health-care facilities in Lagos State, Nigeria, at the beginning of the COVID-19 pandemic by interviewing the facility's main person in charge of health commodities. Data were recorded during the visit and in the previous six months using the adapted Logistics Indicators Assessment Tool (LIAT). In addition, descriptive analysis was conducted based on the World Health Organization availability index.

Findings – The availability of 13 (81%) of the commodities were high, and 3 (19%) were relatively high in the facilities, stock out rate during the visitation and previous six months varied with the commodities: urinalysis strip (22%) and (40%), hydralazine (20%) and (20%), labetalol injection (8%) and (20%), labetalol tablet (24%) and (24%) and sphygmomanometer (8%) and (8%). No stock out was recorded for 11 (69%) commodities. All the facilities observed 9 (75%) out of the 12 storage guidelines, and 36 (72%) had a perfect storage condition score.

Limitations/Implications – Current state of PE/E health commodities in the selected facilities is highlighted, and the strengths and weaknesses of the supply chain in these health facilities were identified and discussed.

Originality/value – These commodities' availability ranged from reasonably high to very high. Regular supportive supervision is germane to strengthening the logistics management system for these commodities to prevent the negative impact on the health and well-being of the people during the COVID-19 pandemic and post-pandemic.

Keywords Pre-eclampsia, Eclampsia, Supply chain, Logistics, Covid-19, Stock out, Storage condition, Nigeria, Essential medicine list, Availability, USAID

Paper type Research paper

1. Introduction

Pre-eclampsia and eclampsia (PE/E) are hypertensive disorders of pregnancy (HDP) that constitute significant causes of maternal mortality worldwide (Dulay, 2020). *Pre-eclampsia* is defined as the new onset or worsening of pre-existing hypertension associated with proteinuria in a pregnant woman after 20 weeks of gestation, while eclampsia is an unexplained generalized seizure in a patient with pre-eclampsia. Both conditions constitute a kind of spectrum of HDP, with untreated pre-eclampsia typically smouldering for a variable period before progressing to eclampsia in about 1 in 200 cases (Dulay, 2020). The classification of disorders under HDP comprises broadly gestational hypertension or pregnancy-induced hypertension, which is hypertension without proteinuria, pre-

eclampsia, chronic hypertension or essential hypertension, which is pre-existing hypertension with or without superimposed PE/E (Program, National High Blood Pressure Education, 2000).

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However, most of the morbidity associated with HDP is caused by PE/E, with approximately 20 others suffering severe morbidity for every single death (Health Canada, 2004).

The HDP is estimated to cause approximately 185 maternal deaths worldwide, with an estimated 62,000 to 77,000 deaths annually (Khan et al., 2006). In addition, PE/E are significant pregnancy-related disorder that accounts for up to 10% of maternal deaths worldwide and around 14% of maternal deaths when combined with other hypertensive conditions of pregnancy (Say et al., 2014).

Abalos et al., in a systematic review of the global and regional burdens of PE/E involving 129 studies across 40 countries and a total of 39 million women estimated the global incidence of pre-eclampsia as 4.6% (95% uncertainty range 2.7–8.2) and global incidence of eclampsia as 1.4% (95% uncertainty range 1.0–2.0) per all deliveries with wide variations in patterns across regions of the world and the highest in the low- and middle-income countries especially sub-Saharan African (Abalos et al., 2013; Khan et al., 2006). These variations may reflect differences in the pattern of risk factors for developing PE/E across these regions. However, more importantly, the management modalities, their effectiveness and how readily available the essential items will play a significant role in the observed differences.

1.1 Study rationale

Worldwide, PE/E happens in up to 10% of all pregnancies (Magley and Hinson, 2022). One of the aims of the Sustainable Development Goals (SDGs) of the United Nations is to lower the maternal mortality rate (MMR) to less than 70 for every 100,000 live births in the world by 2030. The World Health Organization (WHO) estimated the MMR in Nigeria at a high rate of 814 per 100,000 live births (WHO, 2015). Unfortunately, the country continues to record a rise in MMR, similar to other developing countries (Elem and Nyeche, 2016). Although there are effective treatments for pregnancy complications, including PE/E, in 1994, the WHO recognized magnesium sulphate as a standard treatment for eclampsia.

The Nigerian national supply chain policy for pharmaceutical and other health products proposes that the country should build a supply chain system that is unified and responsive for promoting effective health-care delivery (National Supply Chain Policy for Pharmaceutical and Other Health Product, 2014). This vision aimed at constant and uninterrupted provision of health products necessary to ensure an efficient health system and avoid poor outcomes, which will minimize poor health statistics. These potentially fatal conditions can, thus, be prevented by the availability and adequate supply chain management of the PE/E commodities and related supplies, as stated in the Nigerian essential medicine list.

In addition, the unavailability of PE/E health commodities in public hospitals could worsen MMRs. Consequently, this negatively affects the country's ability to achieve the SDG 2030 goal number three of good health and well-being for all, a key target of which is the reduction of maternal mortality.

Women could be at risk of death and illness if there is no adequate supply of required medications and health commodities during pregnancy to control the high blood pressure that underlies the pathophysiology of PE/E. Moreover, this situation could potentially worsen during the COVID-19 pandemic, given the available evidence that management and health services of other disease conditions like HIV and Tuberculosis were affected during

the COVID-19 pandemic (Pai et al., 2022; Nkengasong, 2022). These negative impacts on health services and management of these diseases are likely due in part to some logistics challenges for health and medical commodities occasioned by the pandemic. There, however, remains a need for more information on humanitarian logistics models across Africa for medical and health-care commodities for emergencies, including their sourcing, delivery and distribution (Babatunde et al., 2020; Banomyong et al., 2019).

Oloruntoba, et al. have also recognized these gaps and suggested increased deployment of theoretically rigorous investigations towards improving operations management in humanitarian contexts (Oloruntoba et al., 2019). Justifications for these advocacies are found in the findings of Mugo et al., conducted in fragile and war-torn South Sudan among a group of women and men that revealed grossly inadequate antenatal services characterized by the unavailability of essential medicines, supplies and tools and poor access to available care due to transportation challenges occasioned by combinations of long distances and prohibitive costs unavoidable for the poverty-stricken community (Mugo et al., 2018).

Furthermore, there is a need for more information in the literature on the availability and storage of PE/E health commodities across health facilities in Nigeria. Similarly, to our knowledge, the status of PE/E commodities logistics and availability during the COVID-19 Pandemic in Nigeria has yet to be previously documented.

This study was, therefore, carried out to assess the availability and logistics activities of sixteen items from the Nigerian essential medicine list for PE/E health commodities at selected public health hospitals in Lagos, Nigeria, using the Logistics Indicators Assessment Tool (LIAT) for availability, stock out rate, and storage conditions in use and evaluate the preparedness of the public health facilities in Lagos, Nigeria for handling PE/E at the start of the COVID-19 pandemic. It is hoped that the findings will contribute to the scorecard for health-care providers and assist the Federal and State governments with field-relevant policy formulations.

2. Logistics management of the essential commodities for pre-eclampsia and eclampsia in the health-care system

The third SDG of the United Nations is good health and well-being (Envision2030, 2015). As a prerequisite to the successful implementation of this vision, stakeholders are expected to ensure patients obtain medication that meets the six rights, affecting the product, the quality, the quantity, the time, the place and the cost (all must be right; Envision2030, 2015). PE/E are the second and third most common causes of maternal mortality, respectively, following postpartum haemorrhage (Olonade et al., 2019). While these deaths are avertible, the necessary drugs and instruments to treat these conditions are frequently unavailable in low-resource settings. This is further worsened by poor access to good health-care services.

Supply chain management is a significant component of the health-care system because it improves the availability of health commodities which is a critical facilitator for efficient health-care service delivery. An efficient health supply chain is the backbone for delivering essential supplies, including medicines and medical products. Supply chain management interruption occurs when critical products are unavailable when needed, and inventory management is not optimal (USAID | DELIVER PROJECT, 2011).

2.1 Literature on eclampsia and pre-eclampsia in Nigeria

The incidence of hypertensive disorders in pregnancy is estimated as 9.4% in a prospective cohort study over a year in North-Central Nigeria, with pregnancy-induced hypertension and pre-eclampsia constituting the majority of the cases (64%) of HDP in this study (Idris *et al.*, 2020). The incidence of PE was estimated as 87.9 per 1,000 pregnancies (8.8%) in a similar cohort study (Musa *et al.*, 2018).

The incidence and prevalence of PE/E are high in Nigeria, with estimates varying with the study settings and the methodologies. A prevalence of 4% for PE/E (severe PE accounting for 3.4% and E, 0.6%) was recorded in a six years retrospective study conducted in a tertiary health facility in South-Eastern Nigeria between 2012 and 2017 (Onoh *et al.*, 2019). These findings are consistent with the prevalence of PE/E of 3.6% (PE, 3.02%, E, 0.58%) obtained in a similar six-year retrospective tertiary health facility-based study in the North-Central part of Nigeria between 2014 and 2019 with a case fatality rate of 3.9% and stillbirth in 10.7% (Akaba *et al.*, 2021). Generally, PE is more prevalent than E as not all PE progresses to E. A 10-year retrospective review of cases of eclampsia between 2000 and 2009 in a tertiary facility in South-Eastern Nigeria recorded a prevalence of eclampsia of 0.91%, with maternal deaths in 17.4% mainly due to pulmonary oedema (13.0%), acute renal failure (8.7%) and coagulopathy (6.5%). Perinatal deaths occurred in 25.5% due to prematurity and 82.45 due to low birth weight, with a low Apgar score of less than 7 in 5 min in 41.2% and severe asphyxia in 13.0% (Adinma, 2013). The risk factors associated with severe PE/E are history of pre-eclampsia, pre-existing hypertension, primiparity, being a housewife, unbooked or fewer antenatal care visits, low level of education, unemployed, rural dwellers and use of traditional treatments (Ajah *et al.*, 2016; Guerrier *et al.*, 2013).

Nigeria accounts for 14% of the global maternal death burden and is listed among the ten countries regarded as most dangerous for childbirth and pregnancy complications [National Population Commission (NPC; Nigeria) and ICF International, 2014]. The high maternal and perinatal mortality associated with PE/E calls for appropriate policies and measures towards reducing these burdens, including female education, women empowerment and availability and ready access to appropriate care in rural communities. Adepoju *et al.* demonstrated the positive impacts of improved access to care in rural settings through the ability of community-based health workers to recognize cases of hypertension in pregnancy, deliver methyldopa and magnesium sulphate and make referrals as appropriate (Adepoju *et al.*, 2021).

3. Methodology

3.1 Study design & study sites

This cross-sectional study assessed the availability of health commodities for PE/E in 50 selected health facilities in Lagos State, Nigeria. Lagos State, southwestern Nigeria, is the commercial hub of the most populous African country, with an estimated population of about 22 million. About four million women of reproductive age live in Lagos State, accounting for approximately 22.9% of the total population (Duduyemi *et al.*, 2019). The study was conducted in 50 health-care facilities within the state, comprising 25 primary health-care centres and

25 secondary health-care facilities, selected by convenient sampling. These two public health-care levels serve as the hub for primary and emergency obstetric care operating 24 h services. The list and designations of the contact persons in charge of health commodities in these health-care facilities are listed in Appendix 1.

3.2 Study procedure

Data was collected using an instrument obtained from the relevant sections of the United States Agency for International Development (USAID)-validated LIAT form by a trained data collector comprising two postgraduate students of health logistics and supply chain management (both university graduates with Bachelor of Science in medical laboratory science and the second person with a bachelor of science in microbiology) with the assistance of the contact persons in the facilities studied.

We collected data at the beginning of the COVID-19 pandemic from January to mid-February 2020 on the availability of the products, stock out rate and storage conditions of 16 vital products and commodities for PE/E obtained from the Essential medicine list of Nigeria, namely: Magnesium sulphate injection, Calcium gluconate injection, Corticosteroids (betamethasone or dexamethasone), Diazepam injection 10 mg, Alpha Methyldopa, Urinalysis strip, Sphygmomanometer, Calcium supplement, Low-dose acetylsalicylic acid (Aspirin 75 mg), Labetalol injection, Labetalol tablet, Hydralazine, Nifedipine, 10 mL syringe, 20 mL syringe and Normal saline or Ringers (Essential-Medicine-List-Nigeria, 2020).

The data collectors took inventory of available items at the time of the visit and six months earlier through the inventory records provided by the contact persons or the facility representative. Information collected is to answer the questions in the adopted instruments, such as:

- Q1. Is this item available today?
- Q2. Do you have stock out today?
- Q3. Was the product available in the last six months?

The sampling method is convenient sampling. Data collected at the six-month interval to the day of the visit, the data collected represented the availability and non-availability of the products in the facilities visited since the period that the facilities take the inventory of the health product in their store differs from monthly, quarterly and biannual.

3.3 Study instrument

The study instrument was adopted from the USAID-validated LIAT form (USAID | DELIVER PROJECT). It comprised two sections of the original complete LIAT form that addressed the availability of PE/E drugs and commodities in the facility and the storage facilities. The first section renamed "Section 1", is a questionnaire asking about the availability of the 16 selected PE/E drugs and commodities in the facility with all "yes/no" questions about availability or stock out on the day of the study or stock out within six months earlier. The second section, renamed "Section 2", focused on storage conditions. It evaluated 12 items for products ready to be issued or distributed to clients. The data collectors visually inspected the storage facility using prespecified standards and criteria for each item. All products and cartons

were verified to meet the predefined standards and criteria before a “yes” is recorded, with comments noted as indicated. See [Appendix 2](#).

3.4 Data processing and interpretation

The variables were computed into an excel spreadsheet, and the descriptive analysis assessed the frequency of pre-eclampsia/eclampsia health commodities’ availability, stockout rate (Stockout is a term used in logistics management when you run out of stock, and storage condition. The results were interpreted based on the WHO availability index: >80% = high, 50–80% = fairly high, 30–49% = low, < 30% = very low [[World Health Organization \(WHO\) and Health Action International \(HAI\), 2006](#)]. Greater than 80% availability index indicated that 13 items out of 16 items were available in more than 40 facilities out of the 50 facilities and fairly high denotes that three items were available in 40, 39 and 38 facilities, and these items are available in 50–80% of the facilities. Storage areas that satisfied at least 9 of the 12 criteria (75% of the requirements) were judged acceptable; those that met less than 9 were considered unsuitable ([Shewarega et al., 2015](#)). Appropriate storage conditions of health products are when the manufacturer’s recommended storage condition for the product is vividly followed to ensure the quality of the product is protected.

3.5 Ethical consideration

The Health Research and Ethics Committee (HREC) of the University of Lagos’s College of Medicine gave ethical clearance for this study (CMUL/HREC/02/20/716). Also, approval was obtained from the Lagos State health management board and primary health-care development agency and the management of the respective health facilities. The designated persons in charge of health commodities in the facilities also gave verbal consent to participate in the study.

4. Results and discussion

The availability of 13 (81%) of the 16 commodities tested was rated high (>80% availability index, i.e. health commodities were available in more than 40 of the 50 health facilities visited), while three (19%) were rated relatively high using the availability index (availability of items in the facilities), according to the findings of this study, detailed in [Figure 1](#). The stockout rate varied among commodities over the period evaluated. For example, chemistry urine analysis strip had (22%) and (40%) stockout rates for the day of evaluation and six months earlier, respectively. The stock out rates of other commodities in the facilities on the day of the visit and six months earlier were as follows: hydralazine (20%) and (20%), labetalol injection (8%) and (20%), antihypertensive drug pill (24%) and (24%) and pressure gauge (8%) and (8%). These results indicated that urine analysis strip and labetalol injection as of the time of the visit had a lower percentage of stock out rate than six months earlier.

Some facilities have stock out of some items on the day of the visit and in the previous six months, which is different in all facilities with stock out. For example, eleven facilities have stock out on the day of the visit, and up to 20 have stock out in the last six months for urinalysis strips. This availability of items is not unique to the facilities, and since more facilities did not

have the urinalysis strip in the previous six months (40%) and the urinalysis strip was available in more facilities on our day of visitation, since they had lower stock out of 22%.

These findings contradict an earlier report that stated the reduction in the supply of health commodities during COVID-19 pandemic ([Okafor et al., 2021](#)). The timing of our data collection, which was early into the pandemic (January to mid-February 2020) when the impacts on the changes in the sixteen essential commodities for PE/E might have yet to occur, may explain the differences in our findings.

However, as shown in [Figure 2](#), five (31%) items were out of stock during the visitation period and six months before the visits. Our study’s stockout result appeared moderate but remained a significant observation because of the health commodities involved considering their significance in diagnosing and managing PE/E. Among the items out of stock were urinalysis strips, labetalol injection, labetalol tablet and hydralazine injection. Urinalysis strips are used at routine antenatal visits to detect proteinuria, which in its presence, coupled with elevated blood pressure after 20 weeks of gestation, is diagnostic of PE. Likewise, labetalol and hydralazine are antihypertensive agents used in controlling hypertension associated with PE/E. These stockout records raised concerns that the facilities in the state where they were recorded would not have been well positioned for early diagnosis, prevention and management of PE/E at such periods, a scenario with potential attendant poor obstetrics outcomes. These concerns are consistent with the findings of [Nkamba et al.](#), who showed poor availability of supplies to diagnose, prevent and treat pre-eclampsia in 30 primary health centres (PHCs) and 28 referral facilities (hospitals) randomly selected in Kinshasa, Democratic Republic of Congo with poor knowledge about the prevention and management of PE/E among the health-care providers studied despite their excellent knowledge about diagnosis ([Nkamba et al., 2020](#)). Similarly, gaps in knowledge and clinical practices in the detection and management of PE/E among safe birth attendants (SBA) in Afghanistan, despite adequate supplies of required medicines and commodities, have been identified to increase the risk of maternal and perinatal mortality ([Ansari et al., 2019](#)). It would, therefore, be essential to research the impacts of the knowledge base of the health workers in Lagos State and other parts of Nigeria in the nearest future, learning from findings from these other developing countries.

Furthermore, the implications of health commodities stockouts have been well illustrated by a study among women in Akwa Ibom state, South-Southern part of Nigeria, where stockout and availability of health commodities in public health institutions were demonstrated to be associated with hazards and relapses of the people’s illnesses due to noncompliance with treatment prescriptions, fake drugs, exposure to expired and drugs that are adulterated ([Ikoh et al., 2009](#)).

The availability of Magnesium Sulphate in this study was 100% in all health facilities visited. In contrast, another study from Nigeria reported a lower availability of 47.4%. It noted that better knowledge and awareness of the health professionals in using magnesium sulphate might contribute to its availability ([Duduyemi et al., 2019](#)). However, a study done in Addis Ababa revealed insufficient knowledge and awareness about

Figure 1 Percentage of facilities with availability of health commodities based on WHO availability index

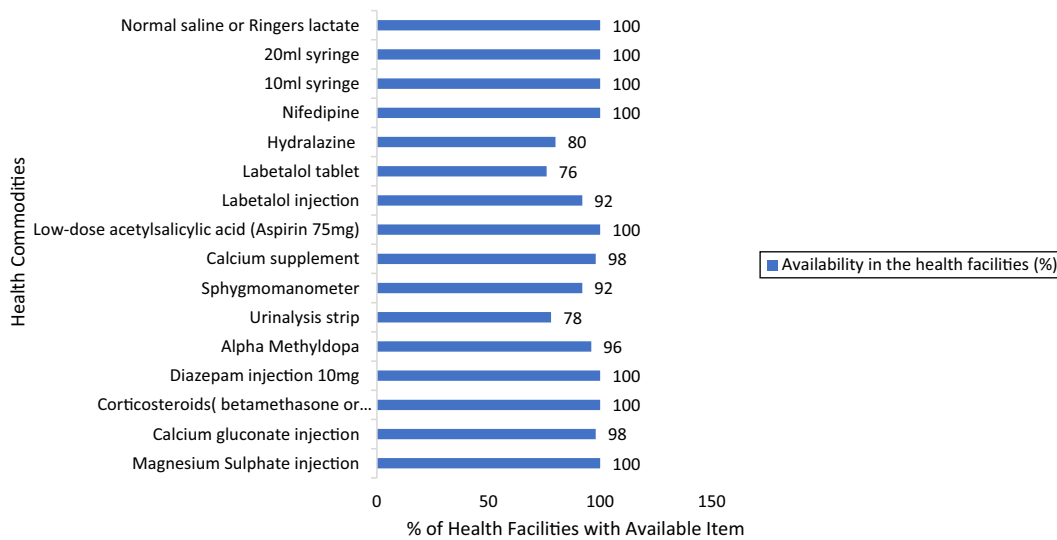
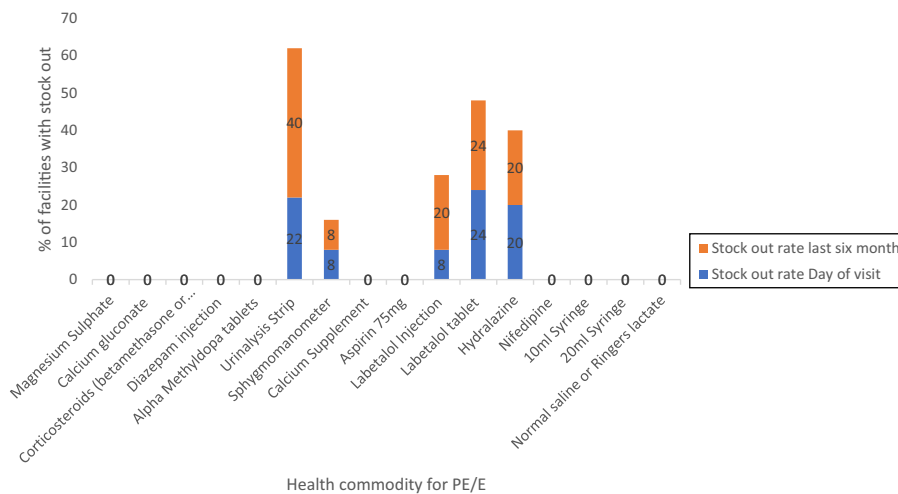


Figure 2 Percentage of facilities with stockout of pre-eclampsia and eclampsia health commodities on the day of visitation and previous months (six)



the level of importance of magnesium sulphate and reported 63% availability (Damtew *et al.*, 2019).

All the 50 health facilities studied observed nine (75%) out of the twelve storage pointers, and 36 (72%) had an ideal score of all the factors for storage condition. It is observed from this study that “13 health commodities (81%)” for PE/E of pregnancy within the essential drug’s list (based on the WHO availability index – >80%) are available; there were still some public hospitals with a few of the commodities below 80%.

Of all the 50 health facilities involved in the study, only 36 (72%) had a perfect score of 100%, as they fulfilled all the storage condition criteria and maintained acceptable storage conditions. In addition, as shown in Table 1, all 50 (100%) facilities have good storage conditions by meeting at least nine of the twelve criteria defined for storage conditions.

According to the survey results, 4% of the facilities visited failed to protect their products and cartons from water and humidity and could not free the storage area from insects and

rodents. As observed in these facilities, the effects of high humidity and exposure of pharmaceutical products to water are complementary, causing the products to absorb water from the environment. These results in degradation and sometimes toxicities in some products, compromising the affected products’ safety, effectiveness and potency. The World Health Organization has recommended an optimal storage condition for pharmaceutical products of room temperature between 15°C and 25°C (59°–77°F) and relative humidity levels around 50%. An increase in relative humidity from 60 and above is potentially dangerous as it enhances the growth of bacteria, mould, fungi and mites. On the other hand, low humidity also results in static build-up, which could dry out medications and affect the intended actions of the solvents used in their production (Kelly, 2018; Szakonyi and Zekó, 2012).

Similarly, the observed access of storage areas to rodents and insects potentially carries many risks to the integrity of the products and the overall safety of the end users. There is

Table 1 Storage condition of pre-eclampsia and eclampsia health commodities in some public hospitals

Serial Number	Storage condition	No. of facilities	%
1	Identification labels, expiry and manufacturing dates are shown in a ready-to-use product arrangement	50	100
2	Product is stored and organised in such a way that they can be counted and managed using the first-to-expire, first-out (FEFO) method	50	100
3	Inspection of the state of the health items; if crushed due to mismanagement, wet or broken due to heat/radiation	50	100
4	Separation and removal of damaged and expired products from inventory on a regular basis	50	100
5	Shielding product from the ray of the Sun	50	100
6	Protection of product in the carton from water and humidity	48	96
7	The storage section is seen to be free of dangerous insects and rodents	48	96
8	The storage facility is locked and keyed, but it is open during regular business hours; access is restricted to authorised workers only	50	100
9	Products are stored at the right temperature based on the required temperature	50	100
10	Proper maintenance of roof to prevent sunlight and water from entering the storage facilities	50	100
11	The storeroom is well-kept	50	100
12	The space presently in use and its organisation are adequate for receiving products	38	76

increasing evidence in recent times showing that antimicrobial resistance occurs in insects, wildlife, rodents and birds. Several insects, including edible ones and those commonly found in households like cockroaches, houseflies, ants, mosquitos, mice and rats, have been reported to harbour antimicrobial-resistant pathogens (Odetoysin *et al.*, 2020; Desvars-larrive *et al.*, 2019; Obeng-Nkrumah *et al.*, 2019).

The products affected by inadequate water and humidity exposures and infestation by insects and pests when the products are used are likely to be non-eficacious. Therefore, centres that may observe some due diligence and put the usage of such compromised products on hold could lead to the non-availability of such products when needed.

While commending the centres that met the set criteria for adequate product storage, adequate measures must be put in place to achieve optimal storage conditions according to international best practices, especially in those facilities that recorded inadequate storage indices. These should include training, capacity building and deployment of necessary instruments and such conditions should be monitored and documented as recommended for quality assurance.

Furthermore, 24% of hospitals needed more storage room for medical supplies. The shortage of storage capacities may be because the current structures and facilities in use at these institutions were similar and have been in use for decades with no expansion.

Presumably from the literature search, this is the first study in Lagos State, Nigeria, to assess the logistics management systems of PE/E health commodities using validated tools (LIAT) by USAID.

The limitation of this study is the number of health facilities studied relative to the total number of health facilities in Lagos State. However, this does not invalidate the outcome and strength of this study, and our findings constitute an indicator of the status of health commodity supplies for PE/E in Lagos State. The fact that maternal and perinatal morbidity remains unacceptably high within the country despite the demonstrated high availability of the studied commodities and medicines calls for a more critical appraisal of the likely causes of mortalities. These perhaps will include questions on access to health-care facilities, lack or inadequate attendance of

antenatal care services, delayed presentations and non-affordability of the commodities as the majority of the population still pay for health care “out of pocket”, a situation worsened by poverty and the socio-economic hardships highly prevalent in the country (Ewelukwa *et al.*, 2013). These findings should inform appropriate interventions.

5. Conclusion

This study centred on the availability, stockout rate and storage conditions of PE/E health commodities in selected public health facilities – secondary and primary levels. The availability of pre-eclampsia health commodities within the facilities varied from a relatively high to high availability index. In addition, we found inadequate storage capability for the selected health commodities.

Overall, the availability of the product, the stock out rate, and the storage conditions from this study indicate a necessity to emphasize and encourage the health-care managers on the need for adequate storage conditions and availability of PE/E health commodities to reduce and possibly eliminate maternal mortality in our community.

The inaccessibility and improper storage of PE/E health commodities in public health facilities might worsen MMRs. Subsequently, it may negatively impact the SDG 2030 goal of good health and well-being.

COVID-19 impact on the outcome of the study may not be established since there needed to be more longitudinal basal data on the supply chain of PE/E items in the studied health facilities before the pandemic. Nevertheless, our results outlined the state of the PE/E essentials items in the studied health facilities. Therefore, health facilities should prepare their PE/E health commodity list and adequately monitor the supply chain and logistics management system. Also, regular supportive supervision would be essential. Furthermore, the ministry of health should take action in Lagos to strengthen the state’s health logistics management structure while formulating policies to improve access and utilization of available maternal and perinatal services.

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Appendix 1

Table A1 List and designations of the contact persons in charge of health commodities in these health-care facilities

S/N	Names of the health facility	Designation of the officer in charge of the Health Commodities
1	Primary Health Center, Akowonjo	Pharmacy Technician
2	Aburu Primary Health Centre	Pharmacist
3	Cele Apata Primary Health Centre	Nurse
4	Ipaja Primary Health Centre	Pharmacy Technician
5	Oshodi – Isolo Primary Health Centre	Nurse
6	Ejigbo Primary Health Centre	Pharmacist
7	Ohekenu Primary Health Centre	Pharmacy Technician
8	Akoka Primary Health Centre	Auxiliary Nurse
9	Ambode Primary Health Centre	Auxiliary Nurse
10	Wright Primary Health Centre	Nurse
11	Palm Avenue Primary Health Centre	Pharmacy Technician
12	Ayantuga Primary Health Centre	Pharmacist
13	Dopemu Primary Health Centre	Auxiliary Nurse
14	Iloro Agege Primary Health Centre	Pharmacist
15	Kwakwa Uku Primary Health Centre	Storekeeper
16	Somolu General Hospital	Pharmacist
17	Mushin General Hospital	Pharmacist
18	Ajeromi Ifelodun General Hospital	Pharmacist
19	Alimosho General Hospital	Pharmacist
20	Ijede General Hospital	Pharmacist
21	Harvey road General Hospital	Pharmacist
22	Lagos Island General Hospital	Pharmacist
23	Ifako Ijaiye General Hospital	Pharmacist
24	Orile Agege General Hospital	Pharmacist
25	Ikorodu General Hospital	Pharmacist
26	Isolo General Hospital	Pharmacist
27	Surulere General Hospital	Pharmacist
28	LASUTH/Ayinke house Ikeja	Pharmacist
29	Gbagada General Hospital	Pharmacist
30	General Hospital, Apapa	Pharmacist
31	Randle General Hospital	Pharmacist
32	General Hospital Ibeju Lekki	Pharmacist
33	Badagry General Hospital	Pharmacist
34	Epe General Hospital	Pharmacist
35	Adeniyi Jones Public health Centre	Pharmacist
36	Agbowa General Hospital	Pharmacist
37	Amuwo odofin Maternal and Childcare	Pharmacist
38	Outreach Women and Children’s Hospital	Pharmacist
39	Military Hospital Yaba	Pharmacist
40	Era General Hospital	Pharmacist
41	General Hospital, Odan	Pharmacist
42	First Consultant Medical Centre	Pharmacist
43	St Nicholas Hospital	Pharmacist
44	General Hospital, Ogba	Pharmacist
45	Abule Egba General Hospital	Pharmacist
46	Lagos Island Maternity Hospital	Pharmacist
47	Deseret International Hospital	Pharmacist
48	General Hospital, Ibeju Lekki	Pharmacist
49	Paelon Memorial Hospital	Pharmacist
50	Louis Medical Hospital	Pharmacist

Appendix 2. Adapted USAID-validated logistics indicators assessment tool (LIAT) form for health commodities for preeclampsia and eclampsia in public health facilities of Lagos state, Nigeria

SECTION 1

Drugs and commodities. This section of the questionnaire asks about the availability of Preeclampsia and eclampsia drugs and commodities in the facility. These are all yes/no questions

Items	Are stocks available? Y/N	Stockout today? Y/N	Stockout last 6 months? Y/N
1	Magnesium Sulphate injection		
2	Calcium gluconate injection		
3	Corticosteroids(betamethasone or dexamethasone)		
4	Diazepam injection 10mg		
5	Alpha Methyl dopa		
6	Urinalysis strip		
7	Sphygmomanometer		
8	Calcium supplement		
9	Low-dose acetylsalicylic acid (Aspirin 75mg)		
10	Labetalol injection		
11	Labetalol tablet		
12	Hydralazine		
13	Nifedipine		
14	10ml syringe		
15	20ml syringe		
16	Normal saline or Ringers lactate		

(continued)

SECTION 2

STORAGE CONDITION: Items 1–12 should be assessed for all facilities for products that are ready to be issued or distributed to clients. Place a check mark in the appropriate column based on visual inspection of the storage facility; note any relevant observations in the comments column. *To qualify as “yes,” all products and cartons must meet the criteria for each item.*

No	Description	No	Yes	Comments
01.	Products that are ready for distribution are arranged so that identification labels and expiry dates and/or manufacturing dates are visible.			
02.	Products are stored and organized in a manner accessible for first-to-expire, first-out (FEFO) counting and general management.			
03.	Products are in good condition, not crushed due to mishandling. Determine if products are wet or cracked due to heat/radiation (fluorescent lights in the case of condoms, cartons right-side up for Depo-Provera®).			
04.	The facility makes it a practice to separate damaged and/or expired products from usable products and removes them from inventory.			
05.	Products are protected from direct sunlight.			
06.	Cartons and products are protected from water and humidity.			
07.	Storage area is visually free from harmful insects and rodents. (Check the storage area for traces of bats and/or rodents [droppings or insects].)			
08.	Storage area is secured with a lock and key, but is accessible during normal working hours; access is limited to authorized personnel.			
09.	Products are stored at the appropriate temperature according to product temperature specifications.			
10.	Roof is maintained in good condition to avoid sunlight and water penetration.			
11.	Storeroom is maintained in good condition (clean, all trash removed, sturdy shelves, organized boxes).			
12.	The current space and organization is sufficient for existing products and reasonable expansion (i.e., receipt of expected product deliveries for foreseeable future).			

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