Risk factors affecting maternal health outcomes in Rivers State of Nigeria: Towards the PRISMA model

[1]Viviane Chinwah
Cardiff Metropolitan University
London School of Commerce Campus
London, SE1 1NX, England
Vivianechinwah92@gmail.com
Tel. +44(0)7848871017

[2]Dr. Frank Nyame-Asiamah*
De Montfort University
Leicester Castle Business School
Leicester, LE1 9BH, England
Frank.nyame-asiamah@dmu.ac.uk
Tel. +44(0)7930498535

[3]Dr. Ignatius Ekanem
Middlesex University
Department of Management, Leadership and Organisation
London, NW4 4BT, England
I.Ekanem@mdx.ac.uk
Tel. +44(0)20 8411 6239

Corresponding author*

Abstract
Existing research suggests that Nigeria accounts for about 23% of the world's maternal mortality ratio, with negative impact on women's wellbeing and the country's socio-economic development. The underlying risk factors of the problem can be categorized into political influences, poor access to healthcare, inadequate utilization of health facilities, poor family planning support and complex pregnancy-related illness. Yet, the complex interrelations amongst the factors makes it difficult to ascertain the riskiest ones that affect women's reproduction and child death, with the existing intervening strategies failing to address the problem. This study identifies maternal health risk factors and prioritizes their management in Rivers State of Nigeria, using the Prevention and Recovery Information System for Monitoring and Analysis (PRISMA) model. Taking a quantitative turn, we applied exploratory factor analysis to analyze 174 returned questionnaires from healthcare professionals working in Rivers State and used the results to establish the relationships between maternal health risk factors and prioritized the riskiest factors. The outcomes indicate that the PRISMA model provides an effective framework for identifying and managing maternal mortality risks that can enable healthcare experts and managers to address the avoidable risk factors and mitigate the unavoidable patient-related risk factors in Nigeria. The implications for theory, practice and policy are discussed.

Keywords: PRISMA model, maternal health, maternal mortality, patient safety, Nigeria, factor analysis

1 Introduction

Nigeria accounts for about 23% of the global maternal mortality with estimated 917 deaths per 100000 lives (WHO et al., 2019). It is amongst the top six developing countries that accounts for the world's 50% of maternal mortality (Hogan et al., 2010; Alkema et al., 2016) and fails to achieve its Millennium Development Goal (MDG) 5 target, which required countries to reduce their maternal death by 75% between 1990-2015. Although research investigations indicate that maternal deaths are preventable (Mackintosh & Sandall, 2016; Kuruvilla et al., 2014; Sreelatha et al., 2015), the post-MDG review suggests that women still die daily from preventable maternal health cases, with 542 per 100000 lives occurring in Sub-Saharan Africa, 157 happening in South Asia and 10 reported in Europe (WHO et al., 2019).

Maternal mortality has several negative socioeconomic implications on people in developing countries where the problem is acute (Kirigia et al., 2014). Family finances deteriorate in households where women serve as the main source of income and then become victims of maternal mortality (Pande et al., 2015; Bazile et al., 2015). This has knock-on effects on the deceased's or victims' older children who often withdraw from schools and assume caregiving responsibilities of their younger siblings (Pande et al., 2015; Molla et al., 2015). In many cases, the caregivers are unable to provide financial, emotional and psychological support for their younger siblings (Knight & Yamin 2015) resulting in malnutrition, depression, poor access to paid healthcare and increasing teenage pregnancies (Pande et al., 2015; Molla et al., 2015; Bazile et al., 2015). Existing research also indicates that pregnancy complications is a leading disability of women reproductive health that causes increased cardiovascular diseases, female suicide and mortality risks (Hollingshaus & Smith, 2015) and infant deaths (Houle et al., 2015). The complexity even increases in Nigeria where the provider-patient ratio of 1343:1 for doctors

and 222:1 for midwives in referral hospitals, to correlate significantly negatively with the high maternal death ratio (Okonofua et al, 2018).

The ramifications of maternal mortality together with the worrying ratios in many African and Asian countries prompted the United Nations to set a new maternal health target, the Sustainable Development Goal 3.1, that seeks to decrease the global maternal mortality fraction to less than 70 per 100 000 live births from the previous MDG target that aimed to reduce maternal death by 75% (WHO et al., 2019). While this new target might compel healthcare institutions in developing countries to improve their healthcare practices, research suggests that the root causes of maternal death and their complex interrelations require a thorough examination that can allow practitioners and policymakers to develop successful interventions to address the problem (Wang et al., 2016; Kuruvilla et al., 2014; Say et al., 2014; Say & Raine, 2007). Such efforts will require ratifying clinical protocols based on evidence-based findings that are capable of detecting, preventing and managing multiple maternal healthcare risk factors and improving quality care of women (Callister & Edward, 2017; Say et al., 2014).

The foregoing concerns of maternal mortality raise the following question: What preventable and mitigating factors affect maternal health outcomes in developing countries? This study identifies maternal health risk factors and prioritizes their management in Rivers State of Nigeria using the Prevention and Recovery Information System for Monitoring and Analysis (PRISMA) model. PRISMA is a clinical tool which is used to identify and analyze causes of mishaps in patient safety procedures and to recommend measures for improving patient care (Habraken & van der Schaaf, 2010; van Galen et al., 2016). The rest of the paper is organized as follows: Firstly, we discuss the causes of maternal mortality and intervening strategies (in Nigeria) to understand the complexity of risk factors that affect maternal health outcomes and

the need to minimize the risks. Secondly, we introduce the PRISMA model as an underpinning framework to investigate the risk factors affecting the maternal mortality and use the model as a guide to design questionnaire instruments which we then administered at three hospitals in Rivers State, Nigeria, to collect data. Thirdly, we analyze the data with exploratory factor analysis to identify the relationships between the maternal health risk factors and we further discuss our findings to establish the factors that healthcare experts and managers can prevent as avoidable and those that they can only mitigate as unavoidable. Finally, we discuss the study's contribution to the literature on maternal health care (Mackintosh & Sandall, 2016; Callister & Edward, 2016; Izugbara & Wekesah, 2018; Okonofua et al., 2017) and PRISMA operationalization (Fluitman et al., 2016; De Vries et al., 2015; van Galen et al., 2016; Martijn et al., 2012) and introduce a new dimension to maternal healthcare management through our PRISMA based questionnaire (PRMQ) that provides a holistic clinical data collection instrument for managing patient safety.

2 Maternal mortality causes and interventions

2.1 Causes of maternal mortality

Political influences and national funding arrangements play a major role in national healthcare quality implementation and systems development (Walt & Gilson, 2014; Madore et al., 2017). A strong political will formulated around rule of law, fair institutional structures and a diverse network of patients, medical experts, activists, technicians, politicians and other interested groups who are committed to reducing maternal mortality provides an effective platform for minimizing infant and mother caregiving risks (Smith & Rodriguez, 2016; Shearer et al., 2016; Smith & Huntsman, 2019). However, politicians can create partisan healthcare policies by aligning national healthcare quality agenda with their political aspirations, but such political-driven tendencies can lead to poor quality care and loss of public trust in governments (Walt

& Gilson, 2014; Smith, 2014). Research indicates that countries with a low political priority for maternal healthcare such as Nigeria, Guatemala, Honduras, India, and Indonesia have high maternal mortality ratios (Shiftman, 2007). Typically, a lack of political commitment towards commercializing magnesium sulphate (MgSO4) drugs to treat pre-eclampsia, a major cause of pregnancy-related mortality in the northern region of Nigeria (Tukur et al., 2013) and making anti-retroviral drugs accessible to women with HIV/AIDS (Msellati, 2009) contributed to high maternal mortality in the country.

Access to healthcare is a complex phenomenon which is often determined by the interaction between resource availability, financial affordability and acceptability of medical solutions by service users in a given catchment area (Evans, 2013; Ntoimo et al., 2019; Lange et al., 2016). To satisfy the complex healthcare needs of different patients and service users, researchers maintain that policies for improving healthcare must be designed to address misplaced quality practices and socio-economic barriers facing the user community (Hunter & Murray, 2017; Say & Raine, 2007). Healthcare accessibility in Nigeria is unfortunately restricted by poor physical infrastructure (Ntoimo et al., 2019; Okonofua et al., 2017), insufficient human and clinical resources (Izugbara & Wekesah, 2018), non-functional primary and specialized healthcare centres (Kruk, 2010) and overstretched tertiary medical facilities (Ogu et al., 2017). The consequences of these are increased waiting times, physical expression of stress by clinicians and poor health outcomes for women (Ntoimo et al., 2019; Ogu et al., 2017) who often fail to utilize maternity clinics, present late in their third trimesters and receive unsuccessful obstetric interventions (Fagbamigbe et al., 2017).

Poor health utilization has remained a major challenge for maternal health delivery in Nigeria, with less than half of the women population not attending the recommended prenatal care and

only 35.8% using safe facility-based baby delivery service in 2013, just an unnoticeable increase of 0.8% from 2008 (APHRC, 2017). The underlying causes of poor health utilization are many and complex, and they include: inability to afford direct healthcare costs or travel costs to hospitals (Ntoimo et al., 2019); a lack of antenatal clinics in some rural communities (Okeke & Chari, 2018); inadequate education and misinformation about hospital delivery (Adjiwanoua et al., 2018; Adedini et al., 2014; Senarath et al., 2007); patriarchal control over women's pregnancy management decisions (Atkin et al., 2015) and reliance on religion and superstitions over medical advice (Aborigo et al., 2015). For some scholars, the prevalence of traditional African beliefs and practices like drinking locally mixed herbs as a substitute for prescribed medication and following prayer and advice by non-medical spiritual leaders dissuade some women from utilizing prescribed antenatal clinics and worsens their maternal health outcomes (Aborigo et al., 2015; Yarney, 2019).

Inadequate access to family planning and misuse of contraceptives together with a lack of women's empowerment to control their own reproductive rights affect maternal health outcomes (Partley, 2016; Brunson, 2019). Although an effective use of contraceptives provides a primary intervention for unwanted pregnancy and its associated complications (Ahmed et al., 2012), some women shy away from seeking medical advice on contraceptive use in Nigeria. Those who are more confident to use contraceptives to prevent unsafe sex and unwanted pregnancies, such adolescent girls, are perceived as promiscuous by the judgmental attitudes of some clinical staff (Jonas et al., 2017). The effect of these behaviors is unsafe abortions and sexually transmitted diseases which exacerbate maternal mortality in Nigeria (Ahmed et al., 2012; Awoyemi & Novignon, 2014). The optimism is to use public education to empower women's reproductive rights, encourage women to access maternal care services and support them to make informed choices about their contraceptive use (Burroway & Hargrove, 2018;

Brunson, 2019), yet there are fundamental medical causes of the maternal mortality (Say et al., 2014).

Globally, 73% of maternal deaths are caused by direct pregnancy-related conditions such as haemorrhage, hypertensive disorder, sepsis, embolism, obstructed labor, septic abortions, while indirect illnesses developed during pregnancies or aggravated by the state of pregnancy such as cardiac or renal disease and HIV/AIDS account for about 27% of deaths (Say et al., 2014; WHO et al., 2019; APHRC, 2017). The challenge is that some women in Nigeria are unaware of their existing chronic conditions (Fagbamigbe et al., 2017) while indirect medical causes have not been given as much attention as direct causes in the country (Adeniran et al., 2019). These concerns provide a precondition for healthcare practitioners to investigate the underlying health conditions of pregnant patients regularly and prepare themselves for obstetric emergencies that can worsen maternal health outcomes (Jauniaux et al., 2006; Lassi et al., 2014: Mackintosh & Sandall, 2016; Say et al., 2014).

2.2 Maternal mortality interventions in Nigeria

Over the years Nigeria has taken steps to reduce maternal and child mortality through poverty eradication (FGN, 2004), public education, quality control measures (FMOH, 2007) and National Insurance Schemes (Onoka, 2014), but these strategies fell short of effective monitoring and holistic mechanisms to improve maternal health outcomes (Callister & Edward, 2017; Uneke et al., 2010; Enuku & Igbinosun, 2012; Erim et al., 2012; Bankole et al., 2009). For instance, the use of Midwives Service schemes to improve access to skilled-birth attendance suffered poor infrastructural facilities and midwife retention issues (Abimbola et al., 2012) while quality control measures such as the use of WHO Safe Child Checklist to reduce avoidable risk at childbirth and Maternal Death Reviews to improve the quality of

obstetric care are deficient of effective training, proper supervision and leadership engagement to support their acceptability (Perry et al., 2017; Hofman & Mohammed, 2014).

Other maternal death interventions implemented through the use of information and communication technology such as Mobile Community Based Surveillance, Open Medical Record System and Abiye Safe Motherhood (Mobile-Health) Project to support medical diagnosis and enhanced health utilization (Obasola et al., 2015) have suffered user illiteracy and design-reality gaps between the rational designers' specifications and actual users' requirements (Bervella & Al-Samarraieb, 2019; Nyame-Asiamah, 2020). For effective healthcare and maternal mortality interventions, researchers recommend a robust holistic mechanism such as PRISMA that can integrate organizational structures, technical expertise, human experience, and patient concerns to identify and minimize the root causes of health risk factors, and improve lives (Martijn et al., 2012; van Galen et al., 2016; Fluitman et al., 2016).

3 The PRISMA model

The PRISMA model is widely used to investigate root causes of medical mishaps. It is an efficient tool for enhancing the quality of healthcare delivery and maintaining patient safety (Sherman et al., 2009). Particularly in the Netherlands, the PRISMA model has been effectively used in the intensive care unit to monitor failures contributing to emergency admissions (van Galen et al., 2016), in a midwife-led obstetrics care to minimize pregnancy risks (Martijn et al., 2012) and in an academic medical center to identify risk factors responsible for unplanned readmissions (Fluitman et al., 2016).

The medical version of PRISMA uses the Eindhoven Classification Model to analyze clinical and non-clinical causes of incidents in healthcare settings into four distinctive risk categories:

organizational, technical, human behavior and patient-related factors (van der Schaaf & Habraken, 2005). The organizational risk factors are threats related to organizational protocols, transfer of knowledge, management decisions, culture and collective behaviors that can cause failures to a functioning system (Habraken & van der Schaaf, 2010). The technical risk factors arise from the poor designs of tools, software, forms and equipment including poor construction of equipment or set ups that cause material defects and system inaccessibility (Mackintosh et al., 2013) while the human risk factors are performance failures caused by individuals' behaviors (e.g. knowledge-based behavior, rule-based behavior and skilled-based behavior) that they use in performing tasks (Habraken & van der Schaaf, 2010; WHO, 2009). The patient-related risk factors are failures emanating from as patients' unique characteristics or conditions that are often unpredictable but can be better managed in clinical settings to reduce harm to lives (Mackintosh & Sandall, 2016).

Consistently recommended as a patient risk management tool for building a quantitative database of incidents and process abnormalities, from which the optimal preventive measures are taken (van Galen et al., 2016; Habraken & van der Schaaf, 2010; Fluitman et al., 2016), we applied the PRISMA model to develop a risk investigation questionnaire (PRMQ) and analyze the ensued data to establish the factors that influence maternal outcomes and determine their order of importance in maternal mortality management in Nigeria.

4 Research context and design

The study was conducted between February 2017-August 2018 and in three tertiary hospitals in Rivers State, Nigeria: The University of Port Harcourt Teaching Hospital (UPTH), Braithwaite Memorial Specialist Hospital (BMSH) and the Military Hospital (MH), after securing clearance from four independent research ethics committees. These hospitals are the

main government-owned specialist hospitals which attract patient from the oil rich Niger Delta regions in Nigeria, with a catchment population of 10 million people (Brisibe et al., 2014). The unique geographical positions of the hospitals and the growing demand for quality care by patients put excessive pressure on staff and the hospital management.

We applied the PRISMA model to develop 47 closed questions around the organizational, technical, human-behavior and patient-related risk factors to identify the root causes of maternal mortality in the three hospitals in Rivers State. The first seven questions were developed to gain the demographic profile of the respondents while the next 40 questions focused more on the research content. We followed a five-point Likert scale format, starting from 'strongly disagree =1' to 'strongly agree=5' to facilitate pragmatic analysis of the data. The questionnaire was initially tested with two nurses to assess its clarity and practicality in the context of maternal mortality in the selected hospitals and no potential issues were highlighted that could negatively impact their rolling out in the full-fledge study.

4.1 Sample

Following stratified and randomized sampling techniques (Senarath et al., 2007; Lim et al., 2017), we selected a total of 250 of clinical and managerial staff who worked at the Obstetrics and Gynaecology Departments of the hospitals and had a broad understanding of maternal healthcare practices and issues. Our reason for selecting the hospital staff exclusively for the study was underpinned by existing PRISMA-based studies that achieved their expected outcomes for reducing patient risk factors without involving patients directly in the studies (Fluitman et al., 2016; Martijn et al., 2012). We initially stratified the target population by 30% male and 70% female, allowing more female staff who might have the natural propensity to experience childbirth to take part in the study. We then partitioned each gender group into

homogeneous subgroups based on the respondents' job descriptions (see Table 1). We further apportioned the subgroups to the three hospitals based on their relative sizes and the ratio of 4:3:3 for UPTH, BMSH and MH respectively. Applying randomized sampling technique, we accordingly distributed the 250 questionnaires to the respondents in the hospitals through our recruited and trained non-clinical staff research assistant from one of the hospitals. Our independent research assistant facilitated the administration and collection of the paper-based questionnaire with the support of one senior manager who volunteered to supervise this task. The respondents' consents were sought at all times and their rights to withdraw were provided.

4.2 Instrument

In all, we received 174 returned questionnaires: 70 from the UPTH, 54 BMSH and 50 MH. We used the exploratory factor analysis on the SPSS version 25.0 package to generate descriptive statistics on maternal health factors and to summarize the large data set into a smaller number of constructs that represent and explain the underlying causes of maternal mortality in three hospitals (Williams et al., 2012). We applied principal axis factoring with oblique rotations to extract the construct validity and check the reliability of the data, the factors and their relationships to understand how they explain the root causes of maternal mortality. Oblique rotations account for correlations between variables and produce a more accurate and representative results (Osborne, 2014) than orthogonal rotations which constrain the factors to be uncorrelated (Fabrigar et al., 1999). We relied on factor extraction criteria of Eigen value >1, scree test, Kaiser-Meyer-Oklin (KMO) value, extracted cumulative variance and parallel analysis (Kaiser, 1960; Osborne, 2014) as inspection controls. We also used recommended correlation matrix values of greater than 0.3 to determine the intercorrelations between extracted factors (Beaver et al., 2013).

5 Results

Summarizing our results into descriptive analysis and factor extraction analysis, we identified maternal health risk factors and their relationships in Nigeria and established the riskiest factors that can be prioritized for effective maternal health care management.

5.1 Descriptive analysis results

The descriptive analysis of the data revealed several risk factors of maternal health which are shortly discussed under the four main PRISMA categorization with their graphical representations showing their scale of relationships, as indicated by Figures 1-4. The overview of the respondents' demographics is reported in Table 1 and described in relation to gender, age, years of experience in the healthcare sector, patient contact, number of years of caring for or having contacts with patients, qualification, and job description. The respondents were: 40.2% nurses, 24.7% midwives, 18.4% doctors, 2.9% medical consultants, 6.3% senior health officers, 1.1% psychologists, 4.6% medical lab scientist and 1.7% counsellors. Only 5.7% of respondents did not have direct patient contact and 40.2% of respondents had more than 10 years' patient contact experience. All the respondents were professionally qualified to perform their job roles.

Insert Table 1 about here

5.1.2 Organizational factors

Organizational risk factors that impeded quality maternal healthcare included ineffective communication processes, poor training and a lack of shared vision. The respondents rated both bottom-top communication and inter-department information sharing poor at 58.5% and 54.6% respectively, with 54% of them saying that responses to queries were slow. The findings

revealed that 55% of the clinical team did not regularly meet to discuss how to improve healthcare practices while 59.2% of the respondents considered staff trainings as out-of-date.

Insert Figure 1 about here

5.1.3 Technical risk factors

The respondents identified poor infrastructure together with a lack of know-how to use many medical equipment as a problem for quality maternal care outcomes. Only fifty-eight per cent indicated they had the technical knowledge and skill to use equipment effectively with a huge 68% highlighting that the hospitals lacked basic infrastructure such as reliable power and gas to support the overwhelming clinical demands. Sixty-two percent also revealed that equipment was not often checked and monitored for functionality while 57% disagreed that equipment was readily accessible when needed.

Insert Figure 2 about here

5.1.4 Human risk factors

The findings highlighted some serious human risk factors of maternal health outcomes that might originate from poor observance of clinical procedures, inadequate clinical knowledge, and poor clinical management skills. Firstly, 58% of the respondents indicated that some clinicians were unable to handle complex/abnormal pregnancy procedures while 55% suggested that emergency procedures for pregnancy care had not been successful. Other clinical procedural concerns raised were patient verification errors (57%), a lack of effective monitoring systems (55%) and poor planning and coordination of clinical tasks (59%). Other

procedural risk factors included failure to discuss incidence in meeting (50%) and unsatisfactory measures address health and safety concerns (52%). Secondly, 51% of respondents disagreed that healthcare team understood what was required to achieve quality maternal care while 59% believed that clinical tasks were not allocated on the basis of staff's knowledge and expertise. Thirdly, the respondents indicated that more than half of clinical errors were caused by inadequate skills of the staff with 55% disagreeing that satisfactory measures were in place to prevent data error while 52% test errors and 52% prescription errors were attributed to poor clinical skills.

Insert Figure 3 about here

5.1.5 Patient-related risk factors

The findings revealed that patients themselves can pose many risks to their maternal health. Only fifty-three per cent of the respondents suggested that women were aware of their existing chronic diseases while 51% disagreed that patients had access to advice and support on maternal care issues. The findings further suggest that about 46% of women were not aware of pregnancy-related illness and that only 30.5% could manage their illnesses even if they were aware. Fifty-five percent of the respondents said that women did not utilize health facilities sufficiently with a major 65% suggesting that poverty and inability to pay healthcare costs might be the reasons for low utilization. The respondents also found the role of culture (54.3%) and religion (56.3%) played in healthcare choices as patient-related risk attributes that impact maternal health outcomes, with only small margin of 23% agreeing that women were able to make their own healthcare decision without other family members interfering.

Insert Figure 4 about here

5.2 Factor extraction results

The factorability of data was considered suitable based on the test of significance: the KMO measures of adequacy (0.927), Bartlett's Test of Sphericity (Determinant=9.243E-22, X=7692.774, df=780, P = .000), and the correlation matrix >0.3. These values demonstrated the significance of data for the study including its fit for factor analysis operationalization (Beavers et al., 2013).

The initial analysis of 40 items generated a 7-factor structure with eigenvalues greater than 1 which represents 77.666% of the total variance. Although statistically significant for the analysis, there were several cross-loadings resulting in very complex relationships among the variables. A further parallel analysis was therefore carried out using the Monte Carlos simulation at 90th percentile, which produced better interpretation of correlation amongst the variables (*see* O'Connor, 2000). The data was then run by the syntax on SPSS software to produce a simulation plot shown in Appendix 1 while a two-factor loading was recommended against the initial 7 factor loadings. The factor loadings accounted for 60.632% of the total variance (See Table 2) which falls into an acceptable variability of the risk factors (*see* Osborne, 2014) with accompanying scree plot presented shown by Appendix 2.

Insert Table 2 about here

The Factor 1 loading consists of the latent failures of organizational, technical and human-related factors which can be classified as preventable or avoidable causes of maternal mortality. Twenty-eight items were loaded in this category ranging from 0.552 to 0.927, with 51.507% explained variance. The top item in the category is 27: 'In my team, tripping and slipping incidents are discussed in meetings' and the least item 16: 'In my team, we are able to deal

with complex or abnormal pregnancy conditions'. In contrast, Factor 2 loadings are patient-related factors, which can be classified as unavoidable causes of maternal mortality. Eleven items were loaded in this category ranging from 0.450-0.719, with 9.126% explained variance. The top item is 34: 'The women in our care are aware of any existing chronic disease(s) before pregnancy and the least item 32: 'The women in our care take medication not prescribed by the doctor'. The results are further discussed to shed more light on risk factors affecting maternal health outcomes in Nigeria.

6 Discussion

The descriptive analysis of the data revealed evidence of technical, organizational, human and patient-related maternal health failures in the healthcare settings in Rivers State, Nigeria. The interplay between these failure categories and their associated risk factors constitute a very complex problem that require application of rigorous risk examination tools and a coordinated action of healthcare managers, practitioners and other healthcare interest groups (Smith & Huntsman, 2019; Shearer et al., 2016). Our PRMQ instrument alongside the exploratory factor analysis enabled us to investigate the risk factors from two main typologies – avoidable causes and unavoidable causes, and further allowed us to prioritize the most relevant risk factors that can be prevented or mitigated early and re-evaluated regularly to improve maternal health outcomes (van der Schaaf & Habraken, 2005).

The study wades into an important discussion in healthcare risk management where every thirteen minutes one Nigerian woman dies from preventable causes during childbirth (APHRC, 2017) and patient safety management should be designed to enable practitioners to prevent harm and lessen unavoidable incidents (Mackintosh & Sandall, 2016) through collective actions (Smith & Rodriguez, 2016; Smith & Huntsman, 2019). Such efforts and processes must

be carried out continuously to prevent, detect and manage the frequently occurring incidents and complex risk factors in the healthcare sector to improve quality care of patients (van der Schaaf & Habraken, 2005; Sreelatha et al., 2015; also *see* Nyame-Asiamah, 2020).

However, the complexity of maternal care risk factors is a serious health problem for the Nigerian healthcare sector (Ntoimo et al., 2019; Erim et al., 2012) and taking the discussion further, the study can corroborate the extant knowledge that the complex interrelations between organizational, technical and human risk factors affect maternal health outcomes (Martijn et al., 2012; Habraken & van der Schaaf, 2010). For instance, it reveals that poor patient safety culture, inadequate health and safety measures, trips and slips at work, a lack of basic clinical equipment, test result errors, and poor obstetric emergency interventions can combine in various ways to endanger maternal care outcomes. The good news is that these factors are avoidable and can be prioritized and prevented. Drawing insights from Factor 1 loading results, the study suggests that practitioners can, for instance, use team discussions effectively to prevent data errors and tripping incidents, handle critical emergencies, innovate safe practices and achieve successful interventions while equipment can also be appropriately designed and used to avoid harm. Team efforts can provide effective leadership and shared values that foster healthy working relationships and quality improvement attitude (Shearer et al., 2016).

More importantly, it is the unavoidable risks relating to patients' behavior and their socio-economic factors that healthcare practitioners might struggle to mitigate in an attempt to improve health outcomes for women in Nigeria (Adedini et al., 2014; Aborigo et al, 2015). Although public health education is used to create the awareness of maternal health and mortality (Burroway & Hargrove, 2018; Senarath et al., 2007), the study suggests that ignorance of some women about their pregnancy-related illness, their preference for cultural

and religious beliefs to medical advice as a cure for illness and their attitude towards self-medications are risks that cannot be easily avoided by obstetricians and other clinical practitioners. It may also be a challenge for clinicians to directly influence maternal health outcomes of women who fail to utilize or access maternal health facilities due to affordability constraints.

However, the Factor 2 loadings give that practitioners can prioritize existing chronic conditions of women and illnesses developed during pregnancies as these emerged as unavoidable top patient-related risk factors that can be mitigated early to avoid negative outcomes. It may be the case of advising those with existing chronic illnesses to undergo early treatment before embarking on their pregnancy journeys (Lassi et al., 2014) or to undergo medical procedures that can permanently prevent pregnancies (Jauniaux et al., 2006) and helping those who develop illnesses during pregnancies to access early treatment (Fagbamigbe et al., 2017). Improvising from the unavoidable risk findings will draw policy advice and recommendations from maternal health researchers to explain how to identify and manage obvious risk factors early in order to alleviate direct causes of maternal death and lessens some indirect causes of the problem (Say et al., 2014; Alkema et al., 2016; Callister & Edward, 2017).

7 Conclusion and Implications

7.1 Contribution

This study applied PRISMA model to identify maternal health risk factors and prioritize their management in healthcare settings in Nigeria. Through the PRMQ instrument and exploratory factor analysis, we have introduced an evidence-based approach to identifying and managing risk factors of maternal health outcomes in Nigeria that adds new theoretical insights to how the complex and high maternal mortality rates in developing countries can be understood

(Ntoimo et al., 2018). It contributes to the existing PRISMA medical-version studies in the Western context (Fluitman et al., 2016) and extends these with new empirical knowledge from the maternal health care literature (Kuruvilla et al., 2014; Mackintosh & Sandall, 2016; Callister & Edward, 2017; Ntoimo et al., 2018) and factor analysis exploration (Osborne, 2014). However, the use of PRISMA makes this work significantly different from other prior maternal health studies in developing countries such as Ntoimo et al. (2018).

From a practice viewpoint, this study has used the perceptions of multi-disciplinary healthcare professionals to ascertain maternal health risks that threaten women's health in Nigeria. It has therefore provided a holistic maternal health risk management instrument to help healthcare managers, clinicians and other health experts to prevent, detect and prioritize patient safety risks from the organizational, technical, human and patient-related failures (Martijn et al., 2012). Understanding these risk categorizations and implementing the instrument is the starting point to prevent health risk ahead of actual incident happening and reduce the harm of unavoidable factors. More distinctly it will help practitioners to prioritize the management of direct and indirect causes of maternal death that may require broader clinical review (Say et al., 2014).

7.2 Implications

Given the significance of maternal health agenda of the SDGs, policymakers can be drawn into this study and tailor their strategic health targets to the organizational, technical, human and patient-related factors of maternal health and use our PRMQ avoidable and unavoidable risk factors to inform their decisions. This can particularly help healthcare policymakers in Nigeria, governments of developing countries and global health organizations' think tanks to develop clinical protocols to promote effective communication between clinical staff and patients,

increase healthcare staff capacity, alleviate maternal mortality risks factors and improve quality health outcomes in high mortality areas.

7.3 Limitations and future research

Despite the uniqueness of the study in its application of PRISMA model, it is limited to the extent to which the findings can be generalized to a wider population. Since the study was limited to only 3 hospitals in Rivers State, it is recommended that the findings of this research be tested on wider population of hospitals in Nigeria. This is to establish the extent to which the model, the approaches and the processes observed in the 3 hospitals is repeated in other hospitals in the country. Although 94.3% of the respondents had experience of caring for maternal health patients in the selected departments, a replication of this study should statistically measure the degree of error between the sample population and actual number of respondents to improve the representativeness of the sample and generalizability.

Obtaining empirical insights from the multi-disciplinary team of health professionals on the basis of prior PRISMA studies excluded patients' own perception of maternal health risk. This omission can be filled by future studies with direct narratives of patients. We also acknowledge that the intricacies and complex relationships of the maternal health risk factors can be explored through robust tools like structural equation analysis and it would be naïve to conceal this prospect from future investigations that extend, contest or corroborate our findings.

References

Abimbola S, Okoli U, Olubajo O, Abdullahi M. J. & Pate, M.A. (2012). The Midwives Service Scheme in Nigeria. *PLOS Med*, 9(5): e1001211.

Aborigo, R.A., Allotey, P. & Reidpath, D.D. (2015). The Traditional Healer in Obstetric Care: A Persistent Wasted Opportunity in Maternal Health. *Social Science & Medicine,* 133: 59-66.

Adedini, S. A., Odimegwu, C., Bamiwuye, O., Fadeyibi, O. & De Wet, N. (2014). Barriers to Accessing Health Care in Nigeria: Implications for Child Survival. *Global Health Action*, 7(1): 23499.

Adeniran, A.S., Ocheke, A.N., Nwachukwu, D., Adewole, N., Ageda, B., Onile, T., Umezulike, A.C., Aboyeji, A.P. & Oladapo, O.T. (2019). Non-Obstetric Causes of Severe Maternal Complications: A Secondary Analysis of the Nigeria Near-Miss and Maternal Death Survey. *BJOG*, 126 (S3): 41-48.

Adjiwanoua, V., Bougmab, M. & Legrandc, T. (2018). The Effect of Partners' Education on Women's Reproductive and Maternal Health in Developing Countries. *Social Science. & Medicine,* 197: 104-115.

Ahmed, S., Li, Q., Liu, L. & Tsui, A.O. (2012). Maternal Deaths Averted by Contraceptive Use: An Analysis of 172 Countries. *Lancet*, 380(9837): 111-125.

Alkema, L., Chou, D., Hogan, D., Zhang, S., Moller, A. B. & Gemmill, A. (2016). Global, Regional, and National Levels and Trends in Maternal Mortality Between 1990 and 2015, with Scenario-Based Projections to 2030: A Systematic Analysis by the UN Maternal Mortality Estimation Inter-Agency Group. *Lancet*, 387(10017): 462-474.

APHRC-African Population and Health Research Centre. (2017). Maternal Health in Nigeria: Facts and Figures. Retrieved from: file:///Users/macbookpro/Downloads/APHRC-2017-fact-sheet-Maternal-Health-in-Nigeria-Facts-and-Figures%20(1).pdf. (Accessed November, 2019)

Atkin, K., Berghs, M. & Dyson. S. (2015). 'Who's the Guy in The Room?' Involving Fathers in Antenatal Care Screening for Sickle Cell Disorders. *Social Science & Medicine,* 128: 212-219.

Awoyemi, B.O., Novignon, J. (2014). Demand for Abortion and Post Abortion Care in Ibadan, Nigeria. *Health Economics Review*, 4(1): 1-9.

Bankole, A., Sedgh, G., Okonofua, F., Imarhiagbe, C., Hussain, R. & Wulf, D. (2009). Barriers to Safe Motherhood in Nigeria. New York, NY: Guttmacher Institute.

Bazile, J., Rigodon, J., Berman, L., Boulanger, V., Maistrellis, E., Kausiwa, P. & Yamin, E.A. (2015). Intergenerational Impacts of Maternal Mortality: Qualitative Findings from Rural Malawi. *Reproductive Health*, 12(Suppl 1): S1.

Beavers, S.A., Lounsbury, W. J., Richards, K. J., Huck, W. S., Skolits, J. G. & Esquivel, L.S. (2013). Practical Considerations for Using Exploratory Factor Analysis in Educational Research: *Practical Assessment, Research & Evaluation*, 18(6): 1531-7714.

Bervella, B. & Al-Samarraieb, H. (2019). A Comparative Review of Mobile Health and Electronic Health Utilization in Sub-Saharan African Countries. *Social Science & Medicine,* 232: 1–16.

Brisibe, S., Ordinioha, B. & Gbeneolol, P.K. (2014). Knowledge, Attitude, and Infection Control Practices of Two Tertiary Hospitals in Port-Harcourt, Nigeria. *Nigerian Journal of Clinical Practice*, 17(6): 691-695.

Brunson, J. (2019). Tool of Economic Development, Metric of Global Health: Promoting Planned Families and Economized Life in Nepal. *Social Science & Medicine,* 71: 1719-1727.

Burroway, R. & Hargrove, A. (2018). Education Is the Antidote: Individual- and Community-Level Effects of Maternal Education on Child Immunizations in Nigeria. *Social Science & Medicine*, 213: 63-71.

Callister, L.C. & Edward, J.E. (2017). Sustainable Development Goals and the Ongoing Process of Reducing Maternal Mortality. *Journal of Obstetric, Gynaecologic, & Neonatal Nursing*, 46(3): e56-e64.

De Vries, A. H., Boute, M. C., Kuppen, M. C. P., Van Merriënboer, J. J. G., Koldewijn, E. L., Pelger, R. C. M., Schout, B. M. A. & Wagner, C. (2015). Patient Safety Risks of Basic Urological Procedures Performed by Junior and Senior Residents. *Journal of Surgical Education,* 72(5): 918-926

Enuku, C., & Igbinosun, P. E. (2012). Challenges of Evidence-Based Practice in Nigeria. *Journal of Medicine & Biomedical Research*, 11: 60–68.

Erim, O.D., Resch, S.C. & Goldie, S. J. (2012). Assessing Health and Economic Outcomes of Interventions to Reduce Pregnancy-Related Mortality in Nigeria. *BMC Public Health,* 12(1):786

Evans, B.A., Snooks, H., Howson, H. & Davies, M. (2013). How Hard Can it be to Include Research Evidence and Evaluation in Local Health Policy Implementation? Results from a Mixed Methods Study. *Implementation Science*, 8(1):17.

Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., & Strahan, E. J. (1999). Evaluating the Use of Exploratory Factor Analysis in Psychological Research. *Psychological Methods*, *4*(3.272-299).

Fagbamigbe, F.A., Mashabe, B., Lepetu, L. & Abel, C. (2017). Are the Timings and Risk Factors Changing? Survival Analysis of Timing of First Antenatal Care Visit Among Pregnant Women in Nigeria (2003–2013). *International Journal of Women's Health*, 9: 807–819.

FGN-Federal Government of Nigeria. (2004). National Economic Empowerment Development Strategy, Abuja, Nigeria: National Planning Commission. Available at:

https://www.cbn.gov.ng/out/publications/communique/guidelines/rd/2004/needs.pdf (Accessed October, 2019).

Fluitman, K.S., van Galen, L.S., Merten, H., Rombacha, S.M., Brabrand, M., Cooksley, T., Nickel, C.H., Subbe, C.P., Kramer, M.H.H. & Nanayakkara, P.W.B. (2016). Exploring the Preventable Causes of Unplanned Readmissions Using Root Cause Analysis: Coordination of Care Is the Weakest Link. *European Journal of Internal Medicine, 30*: 18–24.

FMOH- Federal Ministry of Health. (2007). Integrated Maternal New-born and Child Health Strategy. Abuja, Nigeria*:* FMOH. Available at: https://www.healthresearchweb.org/files/IMNCHSTRATEGICPLAN.pdf (Accessed October, 2019).

Habraken, M.M.P. & van der Schaaf, T.W. (2010). "If only....: failed, missed and absent error recovery opportunities in medication errors", *Quality & Safety in Health Care*, 19 (1): 37-41.

Hofman, J. J. & Mohammed, H. (2014). Experiences with Facility-Based Maternal Death Reviews in Northern Nigeria. *International Journal of Gynaecology & Obstetrics*, 126(2): 111-114.

Hogan, M. C., Foreman, K.J. et al. (2010). Maternal Mortality for 181 Countries, 1980-2008: A Systematic Analysis of Progress Made Towards Millennium Development Goal 5. *Lancet*, 375(9726):1609–1623.

Hollingshaus, M.S. & Smith, K.R. (2015). Life and Death in The Family: Early Parental Death, Parental Remarriage and Offspring Suicide Risk in Adulthood. *Social Science. & Medicine,* 131: 181-189.

Houle, B., Clark, J.S., Kahn, K., Tollman, S. & Yamin, E.A. (2015). The Impacts of Maternal Mortality and Cause of Death on Children's Risk of Dying in Rural South Africa: Evidence from a Population Based Surveillance Study (1992-2013). *Reproductive Health*, 12(Suppl 1): S7.

Hunter, B.M. & Murray, S.F. (2017). Demand-Side Financing for Maternal and New-born Health: What Do We Know About Factors That Affect Implementation of Cash Transfers and Voucher Programmes? *BMC Pregnancy & Childbirth*, 17(1): 262.

Izugbara, O.C. & Wekesah, F. (2018). What Does Quality Maternity Care Mean in A Context of Medical Pluralism? Perspectives of Women in Nigeria. *Health Policy & Planning*, 33(1): 1-8

Jauniaux, E., Farquharson, R. G., Christiansen, O. B., & Exalto, N. (2006). Evidence-Based Guidelines for The Investigation and Medical Treatment of Recurrent Miscarriage. *Human reproduction*, *21*(9): 2216-2222.

Jonas, K., Crutzen R., Van Den Borne, B. & Reddy, P. (2017). Healthcare Workers' Behaviours and Personal Determinants Associated with Providing Adequate Sexual and Reproductive Healthcare Services in Sub-Saharan Africa: A Systematic Review. *BMC Pregnancy & Childbirth*, 17(1):86.

Kaiser, H. F. (1960). The Application of Electronic Computers to Factor Analysis. Educational and Psychological Measurement, 20(1): 141–151.

Kirigia, J. M., Mwabu, G. M., Orem, J. N. & Muthuri, R. D. (2014). Indirect Cost of Maternal Deaths in the WHO African Region in 2010. *BMC Pregnancy & Childbirth*, 14(1): 299.

Knight, L. & Yamin, E.A. (2015). Without A Mother: Caregivers and Community Members' Views About the Impacts of Maternal Mortality on Families in Kwazulu-Natal, South Africa. *Reproductive Health*, 12(Suppl 1): S5.

Kruk, M. E., Porignon, D., Rockers, P. C. & Van Lerberghe, W. (2010). The Contribution of Primary Care to Health and Health Systems in Low and Middle Income Countries: A Critical Review of Major Primary Care Initiatives. *Social Science & Medicine*, 70(6): 904–911.

Kuruvilla, S., Schweitzer, J., Bishai, D., Chowdhury, S., Caramani, D. & Frost, L. (2014). Success Factors for Reducing Maternal and Child Mortality. *Bulletin of the World Health Organization*, 92(7): 533–544.

Lange, I.L., Kanhonou, L., Goufodji, S., Ronsmans, C. & Filippi, V. (2016). The Costs of 'Free': Experiences of Facility-Based Childbirth After Benin's Caesarean Section Exemption Policy. *Social Science & Medicine*, 168: 53-62.

Lassi, Z. S., Imam, A.M., Dean, S.V., Zulfiqar A. & Bhutta, Z.A. (2014). Preconception Care: Screening and Management of Chronic Disease and Promoting Psychological Health; *Reproductive Health*, *11*(3):1-20.

Lim, H, M., Sivasampu, S., Khoo, E. & Noh., K, M. (2017). Chasm in primary care provision in a universal health system: Findings from a nationally representative survey of health facilities in Malaysia. *PLOS One*, 12(2): E0172229.

Mackintosh, N. & Sandall, J. (2016). The Social Practice of Rescue: The Safety Implications of Acute Illness Trajectories and Patient Categorisation in Medical and Maternity Settings. *Sociology of Health & Illness*, 38(20): 252–269.

Mackintosh, N., Watson, K., Rance, S. & Sandall, J. (2013). Value of A Modified Early Obstetric Warning System (MEOWS) In Managing Maternal Complications in The Peripartum Period: An Ethnographic study. *BMJ Quality & Safety*, 23(1): 26–34.

Madore, A., Rosenberg, D.J., Yousif, H., Desmond, C. & Weintraub, L.R. (2017). Politics and Leadership in Global Health Delivery: Lessons from South Africa's HIV and Health Insurance Initiatives. *The Lancet Global Health*, 5 (Suppl 1): S7.

Martijn, L., Jacobs, A., Harmsen, M., Maassen, I., & Wensing, M. (2012). Patient safety in midwifery care for low-risk women: instrument development. *Journal of midwifery & women's health,* 57(4): 386–395.

Molla, M., Mitiku, I., Worku, A. & Yamin, E.A. (2015). Impacts of Maternal Mortality On Living Children and Families: A Qualitative Study from Butajira, Ethiopia. *Reproductive Health*, 12(Suppl 1): S6

Msellati, P. (2009). Improving Mothers' Access to PMTCT Programs in West Africa: A Public Health Perspective. *Social Science & Medicine,* 69(9):807–812.

Ntoimo, F.L., Okonofua, E.F., Ogu, N.R., Galadanci, S. H., Gana, M., Okike, N.O., Agholor, N.K., Abdus-Salam, A.R., Durodola, A., Abe, E. & Randawa, J.A. (2018). Prevalence and Risk Factors for Maternal Mortality in Referral Hospitals in Nigeria: A Multicenter Study. *International Journal of Women's Health*; 10: 69–76.

Ntoimo, L.F.C., Okonofua, F.E., Igboin, B., Ekwo, C., Imongan, W. &Yaya, S. (2019). Why Rural Women Do Not Use Primary Health Centres for Pregnancy Care: Evidence from A Qualitative Study in Nigeria. *BMC Pregnancy & Childbirth,* 19(1): 277-13.

Nyame-Asiamah, F. (2020). Improving the 'Manager-Clinician' Collaboration for Effective Healthcare ICT and Telemedicine Adoption Processes - A Cohered Emergent Perspective. *Information Technology for Development*, 26(3): 525-550

O'connor, B.P. (2000). SPSS and SAS programs for determining the number of components using parallel analysis and Velicer's MAP test Behavior Research Methods. *Instruments & Computers*, 32(3): 396-402.

Obasola, O. I., Mabawonku, I. & Lagunju, I. (2015). A Review of e-Health Interventions for Maternal and Child Health in Sub-Sahara Africa. *Maternal and Child Health Journal*. 9(8):1813-1824

Ogu R.N., Ntoimo, L.F.C. & Okonofua, F.E. (2017). Perceptions of Women On Workloads in Health Facilities and Its Effect On Maternal Healthcare: A Multi-Site Qualitative Study in Nigeria. *Midwifery*, 55: 1–6.

Okeke, E.N. & Chari, A.V. (2018). Healthcare at Birth and Infant Mortality: Evidence from Night-Time Deliveries in Nigeria. *Social Science & Medicine,* 196: 86–95

Okonofua, F., Randawa, A., Ogu, R., Agholor, K., Okike, O., Abdus-salam, R.A., Gana, M., Abe, E., Durodola, A. & Galadanci, H. A. (2017). Views of Senior Health Personnel About Quality of Emergency Obstetric Care: A Qualitative Study in Nigeria. *PLOS One,* 12(3): E0173414

Onoka, C., Hanson, K. & Hanefeld, J. (2014). Towards Universal Coverage: A Policy Analysis of the Development of the National Health Insurance Scheme in Nigeria. *Health Policy Planning*, 30(9): 1105-1117.

Osborne, J. W. (2014). Best Practices in Exploratory Factor Analysis. Scotts Valley, CA: CreateSpace Independent Publishing.

Pande, R., Ogwang, S., Karuga, R., Rajan, R., Kes, A., Odhiambo, F.O., Laserson, K. & Schaffer, K. (2015). Continuing with "…a Heavy Heart"—Consequences of Maternal Death in Rural Kenya. *Reproductive Health*, 12 (Suppl 1): S2.

Partley, P. (2016). Associations Between Quantitative Measures of Women's Empowerment and Access to Care and Health Status for Mothers and Their Children: A systematic review of evidence from the developing world. *Social Science & Medicine,* 169: 119-131.

Perry, W., Bagheri Nejad, S., Tuomisto K, Kara, N., Roos, N., Dilip, T. R., Hirschhorn, L.R., Larizgoitia, I., Semrau, K., Mathai, M. & Dhingra-Kumar, N (2017). Implementing the WHO Safe Childbirth Checklist: Lessons from a Global Collaboration. *BMJ Global Health*, 2(3): E000241.

Say, L., Chou, D., Gemmill, A., Tunçalp, O., Moller, A., Daniels, J., Gülmezoglu, A. M., Temmerman, M. & Alkema, L. (2014). Global Causes of Maternal Death: A WHO Systematic Analysis. *Lancet Global Health*, 2(6): e323–333.

Say, L. & Raine, R. (2007). A Systematic Review of Inequalities in the Use of Maternal Healthcare in Developing Countries: Examining the Scale of the Problem and the Importance of Context Public Health Reviews. *Bulletin World Health Organisation*, 85(10):812-819.

Senarath, U., Fernando, N, D., Vimpani, G. & Rodrigo, I. (2007). Factors associated with maternal knowledge of newborn care among hospital-delivered mothers in Sri Lanka. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 101(8): 823-830.

Shearer, J. C., Abelson, J., Kouyate, B., Lavis, J. N. & Walt, G. (2016). Why Do Policies Change? Institutions, Interests, Ideas and Networks in Three Cases of Policy Reform. *Health Policy & Planning*, 31(9): 1200–1211.

Sherman, H., Castro, G., Fletcher, M., Hatlie, M., Hibbert, P., Jakob, R., Koss, R., Lewalle, P., Loeb, J., Perneger, T., Runciman, W., Thomson, R., Van Der Schaaf, T., Virtanen, M. (2009). Towards an International Classification for Patient Safety: The Conceptual Framework. *International Journal for Quality in Healthcare,* 21(1): 2–8.

Shiftman, J. (2007). Generating Political Priority for Maternal Mortality Reduction in 5 Developing Countries. *American Journal of Public Health*, 97(5):796-803

Smith, S.L. (2014). The Emergence, Growth and Decline of Political Priority for Newborn Survival in Bolivia. *Health Policy Planning*, 29(8): 951-959.

Smith, S.L., Huntsman, M. (2019). Agenda Setting for Maternal Survival in Ghana and Tanzania Against the Backdrop of the MDGs. *Social Science & Medicine,* 226: 135–142.

Smith, S.L., Rodriguez, M.A., (2016). Agenda Setting for Maternal Survival: The Power of Global Health Networks and Norms. *Health Policy Planning*, 31(Suppl 1): 148-159.

Sreelatha, S., Swapnika, D., S, R., Shetty, S. P. & Ramaiaya, R. (2015). Review of Focused Antenatal Care. *Journal of Evidence Based Medicine & Healthcare,* 2(38): 6138-6145.

Tukur, J., Ahonsi, B., Ishaku, M.S., Araoyinbo, I., Okereke, E., Babatunde, O.A. (2013). Maternal and Fetal Outcomes After Introduction of Magnesium Sulphate for Treatment of Preeclampsia and Eclampsia in Selected Secondary Facilities: A Low-Cost Intervention. *Maternal Child Health Journal*, 17(7):1191-1198.

Uneke, C. J., Ezeoha, A. E., Ndukwe, C. D., Oyibo, P. G. & Onwe, F. (2010). Development of Health Policy and Systems Research in Nigeria: Lessons for Developing Countries'

Evidence-Based Health Policy Making Process and Practice. *Healthcare policy*, 6(1): e109–e126.

van der Schaaf, T.W., Habraken, M.M.P. (2005). PRISMA-Medical a Brief Description. Eindhoven: Eindhoven University of Technology, Faculty of Technology Management, Patient Safety Systems. Available at: http://www.who.int/patientsafety/taxonomy/PRISMA_Medical.pdf (Accessed January, 2016).

van Galen, L.S., Struik, P.W., Driesen, B.E.J.M., Merten, H., Ludikhuize, J., van der Spoel, J. I., Kramer, M. H. H. & Nanayakkara, P. W. B. (2016). Delayed Recognition of Deterioration of Patients in General Wards Is Mostly Caused by Human Related Monitoring Failures: A Root Cause Analysis of Unplanned ICU Admissions. *PLOS One,* 11(8): E0161393.

Walt, G. & Gilson, L. (2014). Can frameworks inform knowledge about health policy processes? Reviewing health policy papers on agenda setting and testing them against a specific priority-setting framework. *Health Policy Plan,* 29(Suppl 3): iii6-Iii22.

WHO. (2009). Human Factors in Patient Safety. Review of Topics and Tools Report for Methods and Measures Working Group of WHO Patient Safety. Available at: https://www.who.int/patientsafety/research/methods_measures/human_factors/human_factors review.pdf?ua=1

WHO, United Nations Children's Fund (UNICEF), United Nations Population Fund (UNFPA), World Bank Group, United Nations Population Division. (2019). Trends in maternal mortality: 2000 to 2017: estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division. Geneva: WHO. Available at: https://www.unfpa.org/sites/default/files/pub-pdf/Maternal_mortality_report.pdf (Accessed August, 2020).

Williams, B., McKenna, L., French, J. & Dousek, S. (2013). The Clinical Teaching Preference Questionnaire (CTPQ): An Exploratory Factor Analysis. *Nurse Education Today*, 33(8): 814-817.

Yarney, L. (2019). Does knowledge on socio-cultural factors associated with maternal mortality affect maternal health decisions? A cross-sectional study of the Greater Accra region of Ghana. *BMC Pregnancy & Childbirth*, 19(47): 1-12.

Table 1: Respondent Demographics			
Variable	**Descriptor**	**N**	**Per cent (%)**
Gender	Male	52	29.9
	Female	122	70.1
Age	<25	17	9.8
	25-40	102	58.6
	> 40	55	31.6
Experience	<5yrs	71	40.8
	5-10yrs	59	33.9
	>10yrs	44	25.2
Patient contact	No	10	5.7
	Yes	164	94.3
Patient contact experience	<5yrs	49	28.2
	5-10yrs	47	27.0
	>10yrs	70	40.2
	n/a	8	4.6
Qualification	MBBS/BSc	103	59.2
	PGD	20	11.5
	MSc	14	8.0
	Diploma	37	21.3
Job description	Nurses	70	40.2
	Midwives	43	24.7
	Doctors	32	18.4
	Medical consultants	5	2.9
	Senior health officers	11	6.3
	Psychologists	2	1.1
	Medical lab scientist	8	4.6
	Counsellors	3	1.7

Table 2: Pattern Matrix for 2 Factor Loading Extraction		
Items	**Factor 1**	**Factor 2**
27. In my team, tripping and slip incidents are discussed in meetings.	**.927**	
15. All equipment and tools are well designed by manufacturers to an acceptable standard to allow me to do my job properly.	**.879**	
14. All relevant equipment and tools are set up correctly and kept in a room where I can easily access them.	**.872**	
9. Team members meet regularly to discuss ways to improve safety practices within my department.	**.869**	
18. In my team, successful intervention measures are taken to handle critical conditions and emergencies	**.860**	
24. In my team, adequate measures have been put in place to prevent data entry errors	**.857**	
23. In my team, we have suitable monitoring systems and procedures to keep up to date with changes in patient's care plan	**.855**	
17. In my team, there is a procedure for verifying patient information before attending to them.	**.850**	
25. In my team, adequate measures have been put in place to prevent test result errors.	**.839**	
12. The equipment and resources I use are regularly checked and monitored to ensure that they function correctly.	**.828**	
28. In my team, we have adequate health and safety measures in place to minimize or eliminate trips and slips at work.	**.821**	
22. In my team, adequate planning and preparation is done before any healthcare delivery.	**.816**	
8. I receive regular and updated training for my job role.	**.815**	-.113
6. In my team, we follow a consistent approach to record and report incidence at work.	**.812**	
7. In my hospital, there is an effective way of transferring information between other departments and the gynaecology and obstetrics department.	**.811**	
2. I get quick response to questions and inquiries from my line managers when needed.	**.803**	
20. In my team, we have clear understanding of what to do to achieve quality care.	**.790**	
3. I get regular advice and support from more experienced practitioners for my care giving activities.	**.770**	.105
21. In my team, proper health assessment is done by clinicians before diagnosis of an illness.	**.761**	
5. In my team, we have share values for achieving maternal health objectives.	**.753**	.100
10.We have regular power and gas supply to support our healthcare delivery.	**.753**	
16. In my team, we are able to deal with complex or abnormal pregnancy conditions.	**.740**	.165
11. I have adequate materials, resources and equipment required to perform my job	**.736**	
19. In my team, care delivery tasks are allocated based on staff's knowledge and expertise.	**.727**	
26. In my team, adequate measures have been put in place to prevent prescription errors.	**.690**	.101
1. There is a free flow of communication from junior staff to senior staff	**.638**	.137
13. I have the technical knowledge and skills needed to use equipment and tools effectively for my job.	**.597**	
16. In my team, we are able to deal with complex or abnormal pregnancy conditions.	**.552**	.259
34. The women in our care are aware of any existing chronic disease(s) before pregnancy.	.208	**.719**
35. The women in our care are aware of any illness they develop during pregnancy.	.166	**.703**
33. The women in our care are aware of consequences of their healthcare choices.	.194	**.690**

29. The women in our care have access to advice and support on maternal care and pregnancy related issues.	.292	**.654**
30. The women in our care attend heath care appointments sufficiently.	.139	**.654**
38. The women in our care make healthcare choices based on religious beliefs.		**.636**
39. The women in our care make healthcare choices based on cultural values other than religious beliefs.		**.634**
37. The women in our care have sufficient money to pay for their care expenses.		**.606**
40. The women in our care are able to make their own healthcare decision without other family members interfering.		**.575**
36. The women in our care understand how to manage illness on their own, as recommended by the doctors		**.535**
32. The women in our care take medication not prescribed by the doctor.	.117	**.450**
31. The women in our care mix formal healthcare prescriptions with other forms of traditional care practices.		**.**218
% variance	**51.507**	**9.126**

Figure 1: Respondent's distribution of organizational factors contributing to maternal health outcomes

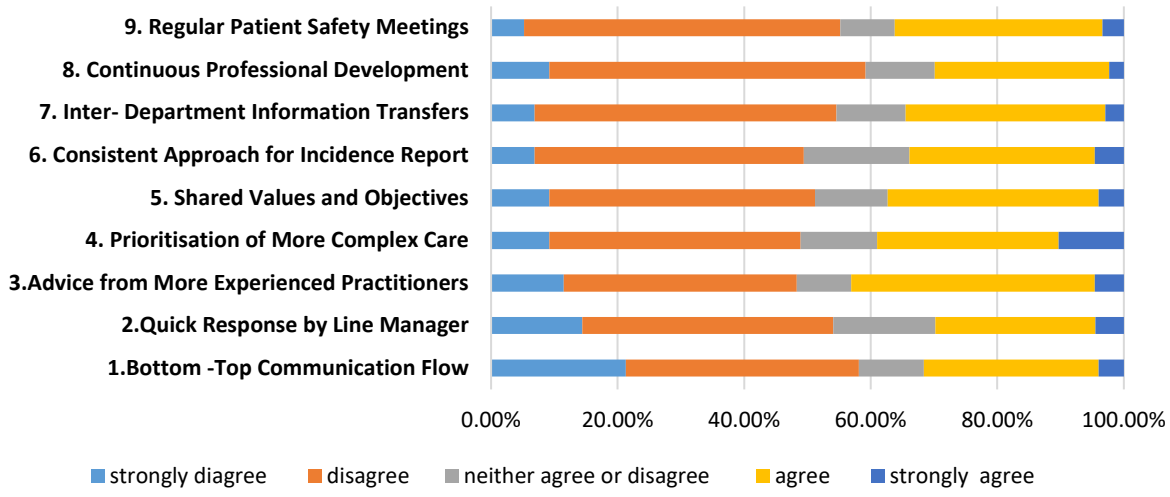


Figure 2: Respondents' distribution of technical factors contributing to maternal health outcomes

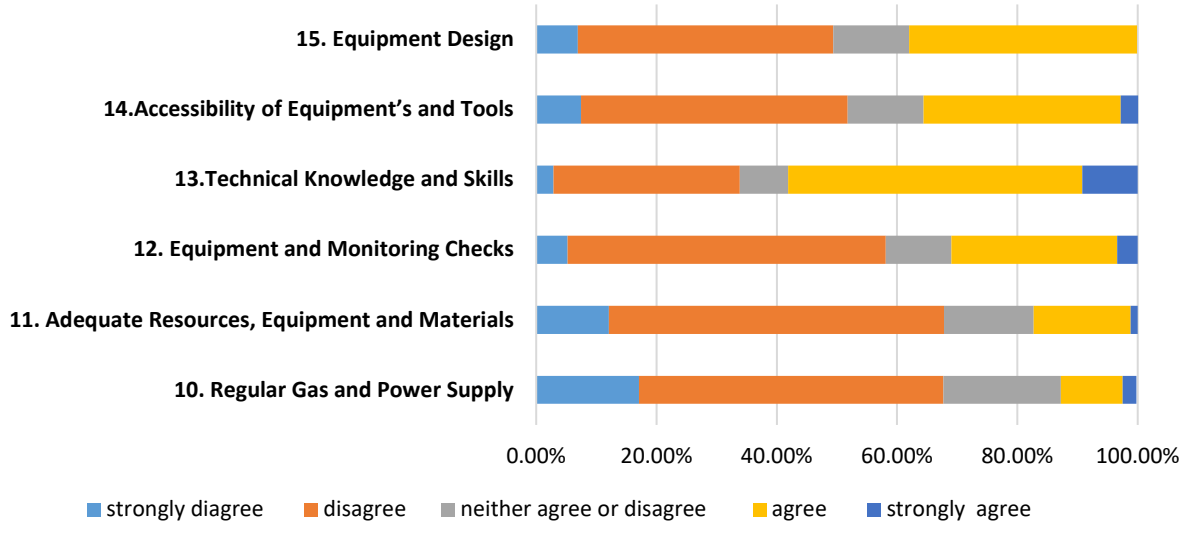


Figure 3: Respondents' distribution of human-behaviour factors contributing to maternal health outcomes

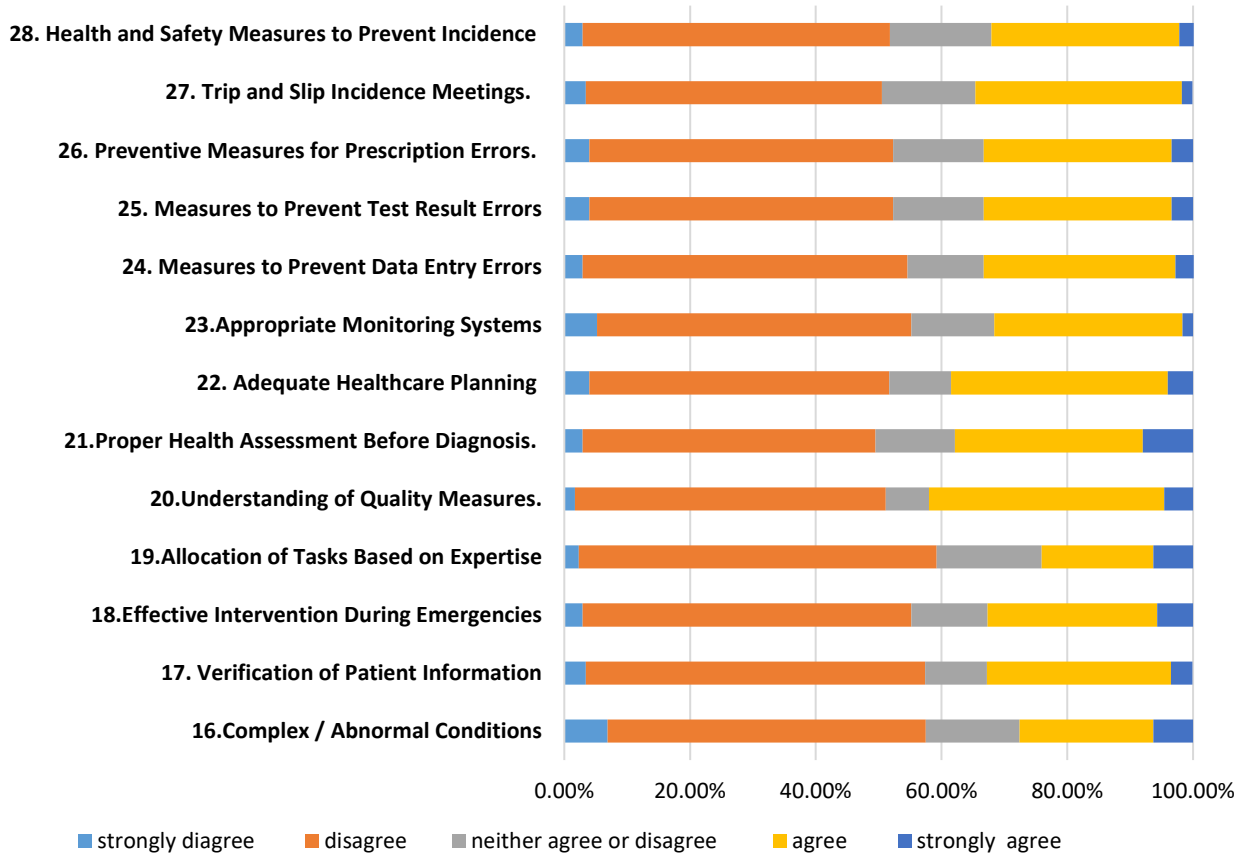
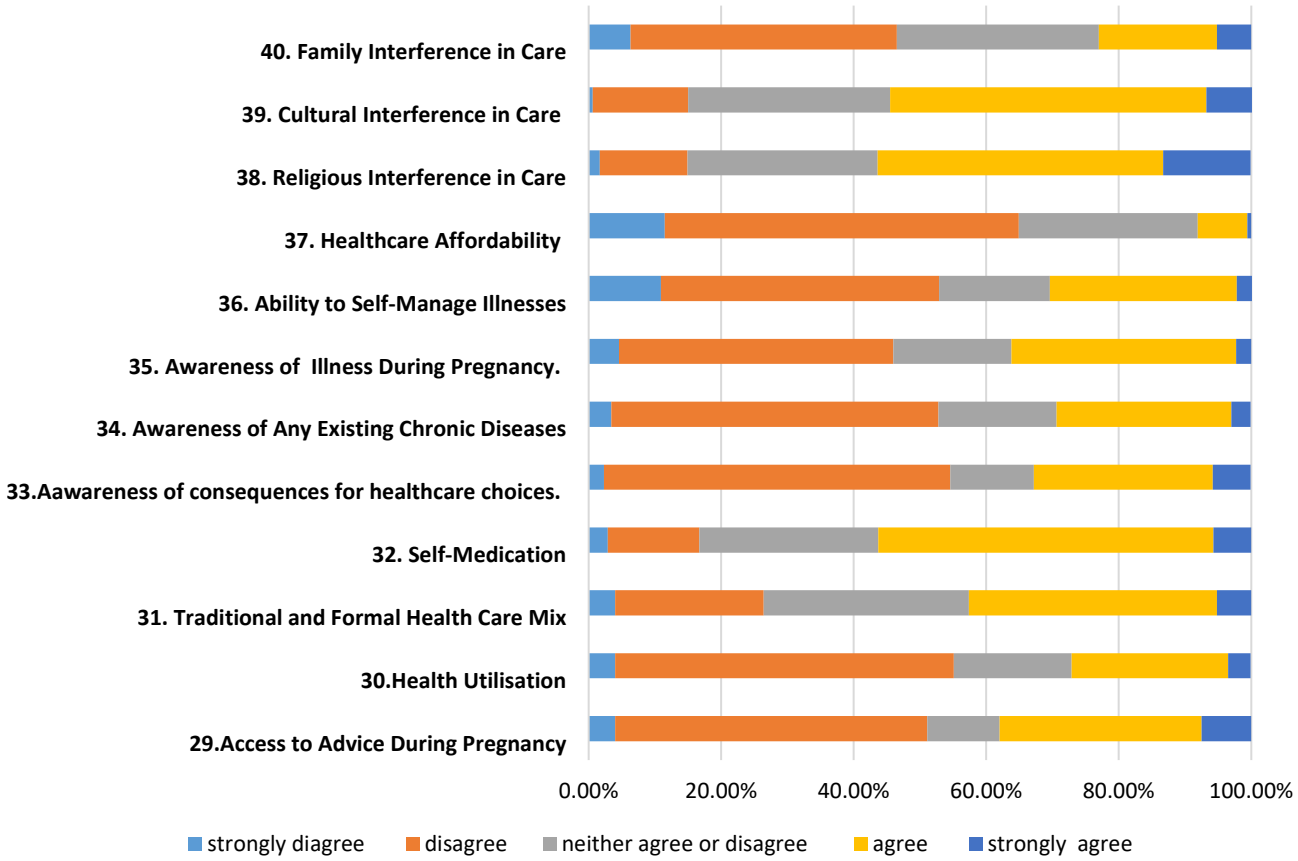
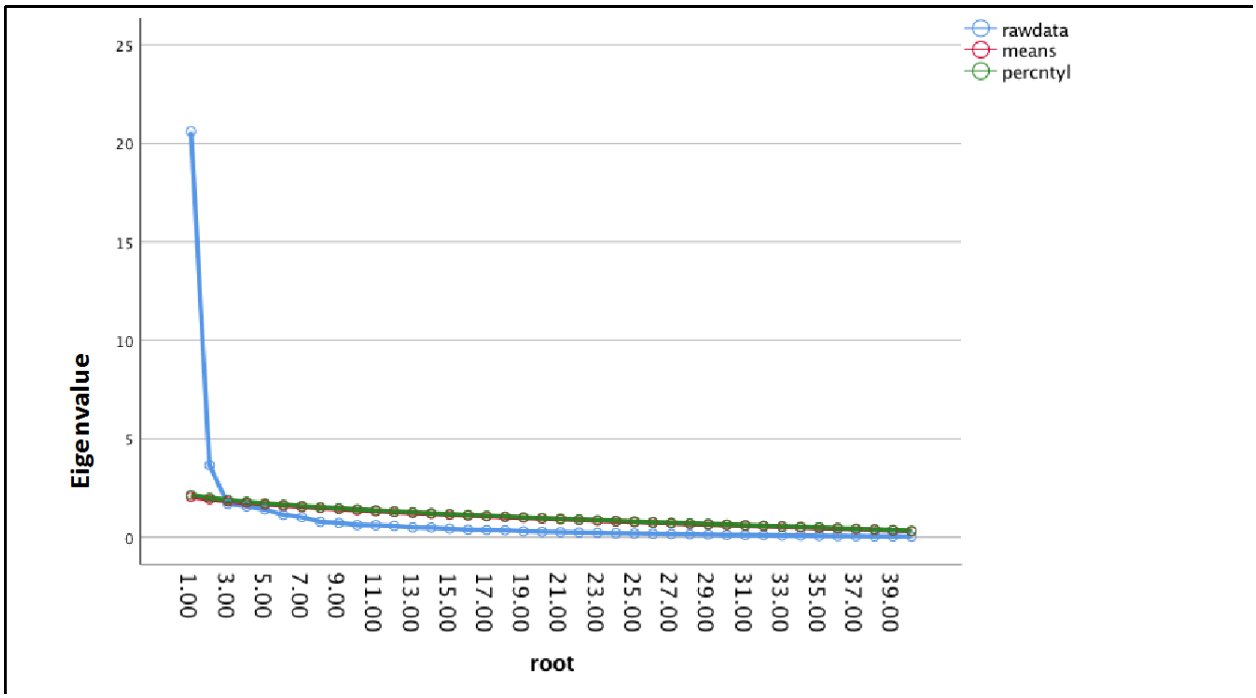


Figure 4: Respondents' distribution of patient-related factors contributing to maternal health outcomes

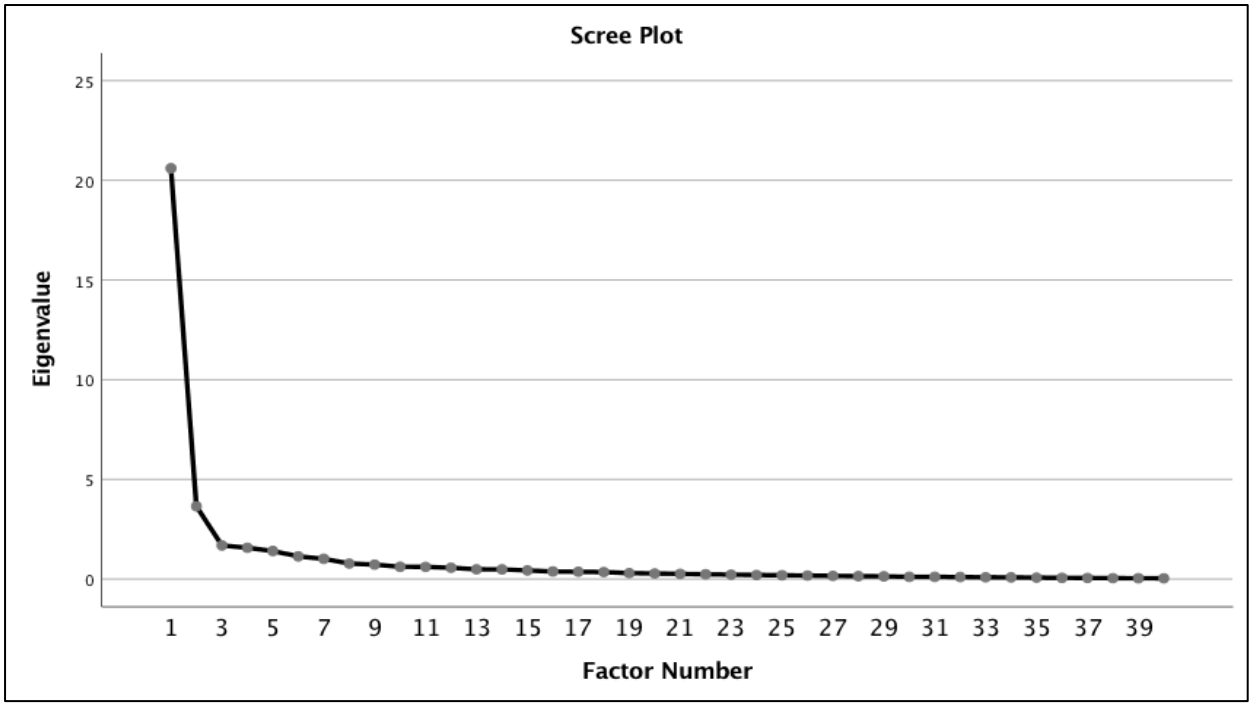


Appendices

Appendix 1: Carlo simulation plot based on 90th percentile values revealing a two-factor loading.



Appendix 2: Scree plot based on two-factor extraction**.**



Highlights

PRISMA model provides a clinical tool for managing maternal mortality risks

Avoidable and unavoidable maternal health risk factors in Nigeria examined

Organizational, technical, human and patient factors affect maternal health outcomes

Clinical data collection instrument for managing patient safety recommended