An Assessment of Infection Control Practices in Delivery Care Units in Edo State, Nigeria

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Abstract

Background: Puerperal infection is the third most common cause of the high rate of maternal mortality in Nigeria. A potential attributable cause of puerperal infection is poor infection control policies and practices in health care facilities. This study was designed to investigate the nature and pattern of existing policies and practices relating to infection control in maternity care centres in Edo state, South-south Nigeria.

Methods: Sixty three health care facilities, including all tertiary and secondary care facilities and selected Primary Health Centres and Private Clinics were sampled from 8 Local Government Areas from the three senatorial districts in Edo State. Three pre-tested tools were adapted to the local setting and used to interview key informants in the health facilities and to observe for practices and records relating to infection control and past experiences of puerperal sepsis.

Results: Of the 63 health facilities, 68.3% reported that they had infection control procedures in place, while only 16 (25.4%) reported that they documented these as manuals or charts. Only 8 facilities had infection control committees; 7 routinely carry out audits of maternal deaths; while 33.3% reported that they had ongoing program for staff training on infection control. Although a high proportion of the health facilities reported that staffs routinely wash their hands before and after sterile procedures, only about half of the facilities were observed to have 24-hour running water during walk-in sessions, while only about two-thirds had soap and antiseptic solutions in delivery and operating theatre areas. Additionally, although more than 90% of the health facilities reported that they use sterile gloves routinely, unused sterile gloves were found in only 60% of these facilities, and re-cycled gloves in 11.1%. There were also poor record keeping as well as wide variations in the reported methods of sterilization and decontamination adopted in the health facilities, with none conforming to known international standards.

Conclusions. The results of this study suggest the need for improved record keeping procedures, the development of appropriate policies, protocols and procedures for infection control, and staff training and re-training on infection control throughout maternity care facilities in Edo State. A public health education and advocacy program to create awareness on clean delivery places as an approach for reducing maternal morbidity and mortality, and to build political will for implementing related activities is also urgently needed.

Introduction

High maternal mortality is presently a major public health challenge in Nigeria. Recent estimates of maternal mortality ratio are reported by various sources as 545 per 100,000 births [1] and 608 per 100,000 births [2], with women having a 1 in 18 lifetime risk of dying during pregnancy [3]. These estimates suggest that about 50,000 women suffer maternal death each year in Nigeria, implying that the country contributes more than 10 percent to current global estimates of maternal mortality. Indeed, Nigeria is currently listed as one of six countries that account for 50 percent of global maternal deaths [2] and is touted as one region of the world where the maternal health-related millennium Development Goal may not be achieved [4, 5, 6].

In Nigeria, puerperal sepsis, defined as "temperature rise above 38.0C maintained over 24 hours occurring from the end of the first to the end of the tenth day after childbirth or abortion [7]" is the third leading medical cause of death in pregnant women [8,9]. Worldwide, the WHO estimates that maternal infection accounts for 15 percent of maternal deaths [10,11]. Although accurate and reliable country-wide data are currently unavailable, estimates from several hospital sources in Nigeria indicates that puerperal sepsis complicates about 1.5 per cent of deliveries [12,13,14] and that it accounts for about 12 per cent of maternal deaths, with a case fatality rate of up to 40 percent [8, 15]. Indeed, our recent report from a tertiary hospital [8] indicates that puerperal infection had the highest case-fatality among the leading obstetric causes of maternal deaths. Puerperal infection has also been identified as a cause of long term reproductive morbidity in women, including secondary infertility [16]. This suggests that puerperal infections are most often severe in Nigeria and that a policy focusing on prevention and early treatment would be valuable in reducing attributable rates of maternal morbidity and mortality.

To date, despite the plethora of activities aimed at reducing maternal morbidity and mortality in Nigeria, very few interventions have targeted the prevention and improved case management of puerperal infection. Some of the factors which predispose to high risks of puerperal infection in Nigeria include home or traditional births in unhygienic conditions, multiple vaginal examinations during labour and childbirth, prolonged labour with or without premature rupture of fetal membranes, caesarean delivery, and co-existing HIV/AIDS [17, 18, 19]. Thus, infections are most often acquired exogenously though endogenous and hospital conditions also play dominant roles.

Edo state, one of Nigeria's 36 states and located in the South-south region performs relatively well in maternal health indicators as compared to the rest of the country. Levels of maternal mortality are consistent with the national average. The state of its maternal health facilities is wooly and has not improved substantially in recent times. Up to 70 percent of pregnant women in the state attend antenatal care in formal health care facilities; 60 percent are delivered by skilled birth attendants (nurses, midwives or doctors); while less than 10 percent of deliveries occur at home or with traditional birth attendants [20, 21, 22, 23]. A notable exception however, is the high proportion of antenatal and delivery care carried out by private health facilities in the

state. Estimates indicate that up to 60 percent of institutional deliveries take place in private health facilities [19, 22], although private clinics often refer difficult cases to public maternity clinics.

Puerperal sepsis accounts for up 12 percent of maternal deaths in Edo state [4]. Due to the high preponderance of institutional births in the state, any effort to prevent infection-related maternal deaths would need to be concentrated in private and public health care institutions. The objective of this study was to assess the extent to which private and public health care institutions in Edo State comply with standard practices for infection prevention and control (clean practices, clean equipment and environment, and availability of appropriate diagnostic and treatment methods) during the management of pregnancy and delivery. We believe the results of the study will serve to highlight the need and gap in infection control practices hence will be useful for informing and designing subsequent interventions to reduce the rate of infections and associated maternal mortality in health facilities in the state.

Methods

The study was carried out by the Women's Health and Action Research Centre (WHARC) in eight Local Government Areas (LGAs) of Edo State, south-south Nigeria, during January to May 2011.

Study Area and Health facility selection

The study was carried out in Edo State, one of the 36 states of the Nigerian federation. Edo state has a population of 3.5 million people (2005 estimate), of which about 70% reside in rural areas. The state comprises three senatorial districts (South, Central and north) and 18 LGAs, with Edo South District being the most populous urban area. A total of 130 health facilities offering maternity services exist in the state. The pattern of distribution of health facilities favours Edo south, with majority of the tertiary and secondary public health institutions as well as private health facilities located in this part of the state. By contrast, Edo Central has only one tertiary institution, a few health centres and private health facilities, while Edo north has no tertiary or secondary health facilities, but only a few primary health centres and private clinics.

The aim of the study was to sample public and private health facilities in the three senatorial districts that have high caseloads of pregnant women undergoing antenatal and delivery care. Consequently, a purposeful sample of health facilities was taken from 8 LGAs that were identified as attending to the highest caseloads of maternity patients in the state. These included four LGAs in Edo South (Egor, Oredo, Ovia north-east and Ikpoba-okha), three in Edo Central (Esan Central, Esan North and Esan South-west), and one in Edo north (Etsako). The number and types of health facilities visited in the LGAs are presented in Table 1. As shown, a total of 63 health facilities were sampled in the 8 LGAs. Based on the available health facilities in the

LGAs, the sampling covered 40% of the Primary Health Centres (PHCs), the only two available secondary/district hospitals in the state, the two tertiary/teaching hospitals in the state, and 50% of the private health facilities in the eight LGAs.

Data Collection

Field work was carried out by staff of WHARC, who underwent a three-day intensive training on the research objectives and study methodology. The field workers were health workers (doctors and midwives) who had participated in previous studies of this kind and were familiar with the project communities. An advanced team booked appointments and received clearance for the interviews and the site visits, after which the actual field study teams attended the health facilities to conduct the interviews and the observations. However, staffs in the health facilities were simply told questions would be asked about maternal health care and were not told that these would be related to infection control. This was to eliminate potential bias in the conduct of the study and the answers given to the questions.

Ethical clearance was provided by the Ethical Review Committee of the Women's Health and Action Research Centre (WHARC). The medical directors and health officials in charge of the various health facilities were contacted and the study rationale and methods were explained to them. Permission to conduct the study was solicited, but none of the health facilities declined to participate in the study. Individual level informed consent was also obtained at the level of the most senior official present at the time of the interview, as well as from officials who were actually interviewed.

The study protocol was adapted from those previously used for the assessment of infection control in health facilities in India [24]. The protocol was restructured to include elements that capture the realities of health care delivery in Edo state and was intensely reviewed by all members of the local research team before use. The protocol comprised three sections. Section 1 was a semi-structured interview guide that elicited information from a senior official in the maternal unit on infection control practices and procedures, while section 2 was a "walk through" protocol format designed to record observations made about infection control practices in the health facilities. In section 3 of the protocol, the research teams examined any existing clinical records, especially those that relate to documentation on previous puerperal sepsis occurring in the health facilities.

The protocols covered various topics including: 1) general information – type of facility, case-loads of parturients, methods for infection control, registers and availability of infection control committees and protocols; 2) infection control practices – hand washing, availability of gloves, whether gloves are re-used, and the use of non-touch aseptic techniques, etc; 3) equipment and supplies – such as gowns, shoe covers, thermometers, disinfectants, etc; 4) the nature of the environment – cleanliness, availability of running water and clean surfaces; and 5) the types and appropriateness of diagnostic and treatment methods and procedures for puerperal infections.

The walk-through observations covered the labour wards, operation rooms, emergency/waiting areas, changing rooms, scrubbing and autoclave rooms as well as treatment, processing and storage areas. The respondents were also requested to recollect and describe how they managed any cases of puerperal sepsis they had seen.

Data Analysis

Quantitative data was analyzed with SPSS Pc+ and were presented as numbers and percentages. It focused on analysis of trends and patterns of responses relating to practices and procedures for infection control in the health facilities. Simple descriptive frequency measures were presented for the various response categories. The results were compared with standard national and international norms and practices. Qualitative data analysis consisted of transcriptions of the interviews conducted with the key informants. The transcripts were analyzed for content and form, especially with respect to the way puerperal sepsis is managed in the health facilities, and then presented as specific narratives.

Results

Sixty three health facilities participated in the study (see Table 1). The respondents were mostly nurses, midwives or nurse/midwives (46, 73%). The others were community health extension workers (4, 6.3%), auxiliary nurses (3; 4.8%), and health managers (2; 3.2%). An obstetrician was the respondent in one private clinic.

Only four health facilities (two teaching hospitals, one specialist hospital and a district/general hospital) indicated that they covered a wide population of more than 500,000 persons. Twenty five (39.4%) facilities covered population sizes ranging between 2000-50,000, while the larger proportion (34, 54%) covered smaller populations of less than 2000 people. The later were mainly PHCs or small private health facilities located in rural parts of the state. Overall, we estimate that the sample serves up to 70 per cent of the state's population.

All health facilities conducted antenatal and delivery care for pregnant women. Uncomplicated deliveries were conducted by nurse/midwives in all the health facilities, while doctors were on standby to manage complicated deliveries. Of the 63 health facilities, 57 (90.5%) had at least a doctor providing back-up maternity services, including operative deliveries. Four secondary and tertiary health facilities reported at least 10 doctors involved in shift duty maternity care. Three tertiary/secondary care facilities reported more than 1,500 deliveries a year. In contrast, the majority (38, 60.3%) reported deliveries of less than 150 per year.

With respect to the infrastructure of facilities, 38(60.3%) had separate labour wards; 31 (49.2%) had separate antenatal wards; while 28 (44.4) had separate post-natal wards. Operating deliveries were carried out in separate theatres in 38(60.3%) facilities, while 27 (42.9%) had separate waiting rooms where first stage labour is managed. However, only the secondary and tertiary care facilities (4) had dedicated operating theatres for maternity units. All PHCs and private clinics used the same theatre for both maternity units as well as for general surgical cases. Of the 63 facilities, 46 (73.0%) reported that they treat women experiencing complications of unsafe abortion, including treatment for incomplete abortion (PAC). As infection control is one of the concerns in providing post-abortion care, we sought information on where uterine evacuation was carried out in the health facilities. The answers indicated that 31 (49.2%) carried out PAC in the same operating theatres used for maternity and general surgical cases, 13 (20.6%) in the labour wards, one in the treatment room and another one in the antenatal ward.

Infection Control Policies and Procedures

The pattern of infection control policies and procedures as reported by the participating health facilities is summarized in Table 2. Up to 68.3% of the respondents indicated that they had standard infection control procedures in place in their delivery rooms. However, only16 (25.4%) had this documented as policies in book/manual, charts or written forms. The majority (42.9%) only communicate these procedures to staff verbally. Also, only 8 (12.7%) health facilities reported that they had infection control committees in place; 7 (11.1%) have regular audits of maternal deaths; 18 (28.6%) have set standards for infection control in their maternity units; while 21 (33.3%) reported that they have regular training for staff on infection control. Only three facilities reported that they managed cases of hospital-acquired infection in the month preceding the interviews.

Regarding the actual practice of infection control and aseptic procedures in the facilities, the results are presented in Table 3. All 63 facilities reported that their staffs routinely wash their hands after procedures and that soap is available at all times for hand washing. However, only 92.1% of staffs wash their hands routinely before procedures, while 54 (85.7%) reported that staffs vigorously rub their hands with antiseptic and/or water before aseptic procedures such as vaginal examination.

Up to 59 (93.7%) health facilities reported that they use sterile gloves routinely; 92% reported that gloves are used with aseptic preparation; while 87.3% wear gloves with non-touch techniques. By contrast, up to 14 (22.2%) health facilities stated that they re-use gloves. As shown in Table 5, high proportions of the health facilities indicated that they routinely prepare surgical fields using standard techniques and that they promptly replace torn gloves at surgery. There were also high frequencies of reporting of routine hand washing, maintenance of aseptic precaution for episiotomy care and on routine advice given to patients on infection control. However, only 46.0% reported that they had protocols for training new staff on infection control,

while the same proportion reported the existence of on-the-job training for staff on infection control.

Observed Infection Control Practices

The observed practices seen during the walk-in observations in labour/delivery suites and operating theatres are documented in Tables 4, 5 and 6. Sterile gloves were only immediately available in 60.1% of the facilities, while in 11.1% only re-used (re-cycled) gloves were available. Running water was evident in 33 (52.4%) labour wards, with all having wash basins equipped with elbow or/and knee taps. Washing soap was available in 41 (65.1%), antiseptic solutions in 40 (63.5%), while scrubbing brushes was only found in 20 (31.7%) facilities.

Wall posters relating to infection control were seen in 14.3% of the health facilities, while thermometers were found in 52.4%. However, only in 34.9% of the health facilities were there documentary evidence that temperature records/charts of patients were kept. Also, only in less than 50% of health facilities were staff seen washing hands before or after gloving to examine patients.

The observations in the operating theatres followed a similar pattern (see Table 6). Twenty-four hour running water was only available in 42.9% of the operating theatres; soap in 50.8%; scrubbing brushes in 49.2%; and sterile gloves in 49.2%. Furthermore, sterile laparotomy packs could only be found in 25.4% of the operating theatres inspected; sterile gowns in 41.3; sterile gauze in 52.4; and sterile linens in 38.1% of facilities. Automatic mechanisms for opening and closing doors as a way to avert infections was found in only three operating theatres visited.

Infection protective items and sterilization techniques

We also looked for the availability of protective wears in or near delivery suites or operating theatres that are necessary to prevent exogenous infections. The results showed that protective aprons were present in or near labour wards in 69.8%, in operating theatres in 68.3%, and in treatment rooms in 66.7% of the health facilities. By contrast, protective caps and face masks were less seen in these areas. Protective head caps were seen in labour wards, operating theatres and treatment areas in 33.3%, 60.3%, and 4.8% of health facilities, respectively. Similarly, face caps were identified in labour wards, operating theatres and treatment areas in 36.5%, 65.1% and 1.6% of health facilities, respectively. Dedicated foot wears or boots (to replace foot wears normally used by health care providers) was present in 58.7% of the operating theatres visited, in 34.9% of labour wards, and in 6.3% of treatment rooms. Similarly, protective shoe covers were found in 50.8% of operating theatres, 23.8% of labour rooms and in 6.3% of treatment rooms. Other protective devices – eye wears, nail cutters, and nail brushes – were much less commonly seen in operating theatres, labour wards and treatment rooms. Except for nail brushes which were found in operating rooms in 42.9% of health facilities and 22.2% of labour wards, the others had much lower frequency of occurrence.

The sterilization practices for delivery care reported in all the health facilities also varied widely. Although 62 (98.4%) health facilities reported that they routinely sterilize instruments used for both normal and operative delivery, only 58 (92.1%) could describe the method they used in some detail. Among the 58 health facilities, 53 different responses on sterilization methods were described, indicating a high level of disparity in sterilization practices between the health facilities. Additionally, the described procedures did not follow universal guidelines on sterilization techniques. Some of the most frequently described procedures were: 1)*"uses stove, boil instrument for 40-50 minutes in a big pot (container); 2) "washes instruments with soap and water, boil in the sterilizer, dry and pack"; 3) "washes instrument and soak in hibitane water, autoclave for 30-60 minutes"; 4) washes instrument with soap, water and jik (jik=sodium hypochlorite, with10% active chlorine), leave to dry and sterilize in autoclave: and 5) "packs instrument after washing and autoclave for one hour"*

The methods for disinfecting operating theatres also varied widely. Of the 63 health facilities, only 43 (68.3%) reported that they routinely disinfect their operating theatres. Of the 43 facilities reporting routine disinfection, 33 different responses on the methods used for disinfecting operating theatres were presented. The most frequently reported methods of disinfection were: *1) fumigates and use the air conditioner, cleans the theatre and items therein, 2) uses centrimide to scrub and spray which contains vapor and dettol, 3) dusts the area and uses methylated spirit to clean equipment, and 4) cleans with jik and detergent.* None of the described methods met basic operational standards for routine disinfection of operating theatres. Additionally, most of the health facilities did not have standard procedures for disinfecting air in operating theatres. The methods described included use of fumigation, air conditioners, ceiling fans, air fresheners, fresh air and positive pressure of sterile air.

Suction machines and related attachments are another potential source of cross-infection in labour rooms and operating theatres. We therefore solicited information on how these are disinfected in the health facilities. The results revealed that 52 (82.5%) health facilities routinely disinfected their suction machines and attachments. Of the 52 respondents, 45 different methods were described, again demonstrating wide variance in the methods used. The most commonly described methods were: 1) *"uses jik and savlon* (savlon=0.3g chlorhexidine and 3.0g centrimid as ingredients per 100 ml, and 2.84% m/v n-propyl alcohol and 0.056% m/v benzyl benzoate as preservatives)", 2) *"oxygen tubes and cups are changed when dirty and soiled", 3) "boils for 30 minutes", 4) "removal of underwater seal jars, which is replaced every week", and 5) "empty the bottle, wash with anti-septic solution, tubes are soaked in jik solution for as long as they are not in use".*

Lighting sources and movable trolleys are other sources of hospital infection. Our inquiry showed that 58 health facilities (92.1%) had procedures for cleaning light sources and trolleys as a means of preventing infection. The most frequently reported responses were: 1) *"cleans with disinfectant from top to bottom and the lighting is cleaned with damp cloth" (*reported by 6 respondents*); 2) "cleans table, light and trolley with purit and water", 3) "trolley and couch are*

cleaned with jik and purit", 4) "uses savlon in water to wash the bottles and changes the suctioning tubes after each procedure", and 5) "the lighting is removed, dusted with dry towel, while trolley is cleaned with jik solution and disinfectant".

Evidence of Puerperal infection – diagnosis and treatment

Of the 63 health facilities visited, 9 (14.3%) reported current or previous puerperal infection. Examination of existing records in the health facilities showed documentary evidence of four cases of puerperal infections in four separate facilities. The number of case records that were examined to identify a case of puerperal sepsis in each of the four health facilities were 28, 74, 108 and 110 respectively, indicating an infrequent occurrence of infection. Of the 63 health facilities, 44 (69.8%) reported that they had diagnostic facilities for puerperal infections, including blood culture. However, only 37 (58.7%) knew about the most common organism(s) causing puerperal infection in the preceding four weeks. However, the organisms they listed varied widely and included malaria parasites (39.7%), staphylococcus aureus (27.0%), streptococcus (9.5%), and salmonella typhi (25.4%). Less frequently mentioned causes were coliform organisms, klebsiella, shigella, tuberculosis and enterobacterecae.

Of the 9 documented puerperal infections, health providers indicated that the infections were acquired from outside their health facilities in 8, while one was acquired from outside in one case. Some of the cases reported by midwives and one interviewed doctor are as follows:

Case 1: "… about 2 weeks back. She was very poor, her temperature was high, she could not help herself. She was referred from a private hospital.…… I would say the environment in which she delivered may not have been hygienic enough. She delivered with a traditional birth attendant (TBA) and most people don't pay attention to personal hygiene, and more so this particular patient being a psychiatric patient and you know they don't take care of their personal hygiene…. Her mental case may have affected her. In this case, she should have booked in a hospital and the TBA should have told her what to do. Also, because of her mental state, people around her should have helped her….."

Case 2: "… about 15 months ago. She delivered somewhere and then she only came to us. She was very weak, always running temperature, she was pale and she had to be transfused (with blood). She also had vaginal discharge and a bulky uterus. She was placed on antibiotics and was treated for malaria also. She was given augmentin and flagyl (metronidazole). We don't have detailed records on her but this is what we can recall."

Case 3: "… 12 months back. The woman gave birth in our hospital. She had prolonged obstructed labour. She was managed with caesarean section, but later developed puerperal sepsis. She got well and was later discharged. She was delivered here, so she could not have acquired it outside here. You know puerperal sepsis is neglect by a woman…. So, it can happen to any woman because of her poor personal hygiene. We administered antibiotics duly, we gave

her adequate care but her poor hygiene through her vulva and external genitalia may have added to the problem."

Discussion

The study was designed to investigate the nature of existing policies and practices regarding the control of infection in public and private delivery places in Edo state of Nigeria. Although a significant proportion of women in the state still deliver with traditional birth attendants, the government has identified the need to promote the use of skilled birth attendance as a crucial approach to reduce maternal mortality. The recent establishment of the expanded national Midwifery Scheme by the National Primary Health Care Development Agency [25] enables maternal health care to be officially provided by Primary Health Centres by trained midwives who then refer complicated cases to secondary and tertiary health facilities. Under this arrangement, private health care facilities function as primary or secondary health facilities depending on their level of human and infrastructural resources to augment the services provided by public health facilities.

The results of this study reveal the lack of a strategic approach to the prevention, control and management of infection in public and private delivery health facilities in the state. To date, there are no clear guidelines set for the control of infection in delivery places either in the state or at the national level. In contrast, there are now several guidelines that set benchmarks and standards for infection control in maternity units, especially within the context of developing countries [26, 27, 28]. These include the strategic development of an institutional infection control program, consisting of infection control committees and infection control teams, the use of infection control manuals, audit of maternal deaths, and the education and training of health care staff on infection control. Despite these available methods, the results of this study (summarized in Table 6) indicate that only a few of the health facilities visited had infection control procedures in place, the majority of which were not documented. Also, only 8 facilities reported that they had infection control committees, only 7 routinely carry out audits of maternal deaths, less than 15% had wall posters relating to infection control, while only a few facilities had ongoing program for staff training on infection control. Clearly, there is a need to identify a way to institutionalize and integrate the practice of infection control in maternity units in these health facilities.

New technological approaches for preventing and treating puerperal sepsis in health facilities have also been developed. These include improved hand washing techniques, hand rubs with antiseptic solutions, the use of low cost disposable equipment, improved antibiotics and available microbiological diagnostic methods [29]. However, although a high proportion of the health facilities reported that staffs routinely wash their hands before and after sterile procedures, only about half of the facilities were observed to have 24-hour running water during walk-in sessions,

while only about two-thirds had soap and antiseptic solutions in both delivery and operating theatre areas. A large number of health facilities relied on occasional running water or water brought into the delivery and operating rooms in containers, which limits their ability to prevent infection optimally during delivery or operative sessions. Additionally, although more than 90% of the health facilities reported that they use sterile gloves routinely, sterile gloves were found in only 60%, and re-cycled gloves in 11.1% of facilities. Taken together, these observations suggest that health facilities may not have put in place effective mechanisms and resources for implementing infection control activities.

Furthermore, protective wears to prevent cross-infection were in short supply in both delivery, operating and treatment areas in all the health facilities visited. The routine sterilization of delivery and operating instruments is another recommended method for infection control, for which the WHO has set guidelines and minimum standards [30, 31]. By contrast, the results of this study showed considerable variance in the methods used by health facilities for sterilization and decontamination. Various methods that did not meet the basic minimum standards were reported by the health facilities for sterilization of equipment, decontamination of suction materials and for disinfection of light sources, movable trolleys and the environment. In view of the wide variety of methods described, it is possible that health facilities are either not conversant with current best practices relating to sterilization or decontamination procedures or that they have limited resources to implement the proper procedures. Thus, health systems strengthening approaches are required that will integrate sterilization and decontamination procedures into the organogram, infrastructural maintenance and governance processes of health facilities at all levels.

The lack of proper record keeping relating to maternity care and statistics on infection was another important finding of this study. Only a few of the health facilities kept some record on their previous experiences of puerperal sepsis, the majority of which were not systematically collected or documented. The result was the lack of appropriate data that would allow proper identification of the pattern and determinants of puerperal sepsis in the health facilities. Thus, only oral evidence was provided for the nine cases of puerperal sepsis that were reported, which did not permit the full elucidation of the circumstances surrounding their development and management. Clearly, efforts to properly document all cases of pregnant women managed in the health facilities, especially those experiencing infection, should be part of efforts to monitor and improve the various activities relating to infection control and management in the state.

This study has potential scientific limitations. These include the fact that not all the health facilities were investigated, while health facilities were sampled from only 8 of the 24 Local Government Councils in the state. However, as explained earlier we concentrated on health facilities that provide high loads of maternity care in the state. The results of our initial health facilities scan in the state indicate that the 8 selected LGAs provide up to 70% of the maternal health care services in the state. They include all tertiary and secondary health care facilities as

well as the majority of private health facilities that provide maternity care. Thus, we believe the results of the study can be generalized to all parts of the state.

Another potential limitation of the study is the fact that the interviewers were not blinded to the health facilities they investigated, neither were there adequate records to authenticate the claims made by the key informants. However, the intense training provided to the interviewers and the fact that none was familiar with the individual health facilities which they visited mitigated the level of potential bias in the responses obtained. Furthermore, the addition of the walk-through sessions was valuable in confirming the responses obtained during in-depth interviews and reduced the liability due to the lack of existing medical records.

A previous operations research intervention that focused on the prevention and treatment of puerperal infections [14] failed to make recommendations on sustainable system-wide reforms for implementing and institutionalizing best practices for infection control in Nigeria. Despite its potential shortcomings, the results of this study enables us to make a number of recommendations for improving infection control and management in delivery places in Edo state can be made as follows:

- Infection control in maternity units should be prioritized as a major strategy to reduce the high rate of maternal morbidity and mortality in Edo state. Guidelines for infection control should be developed and made available to all health care facilities providing maternity care in the state. This should include the constitution of infection control committees, and regular audits of maternal deaths and of puerperal sepsis.
- Evidence-based protocols for infection control should be developed, standardized and provided in all health care institutions. This should include protocols for hand washing, the sterilization and decontamination of equipment, reuse of materials, fumigation, environmental cleanliness, and the rationale use of laboratory tests and antibiotics.
- Appropriate policy for maintaining and sustaining the supply of materials essential to infection control in maternity units such as soap, 24-hour running water, antiseptic solutions, anti-septic hand rubs, facemasks and hand gloves should be developed and implemented in all health facilities in the state. As part of a purposeful infection control measure, regular surveillance should be put in place to ensure that these items are always available.
- In view of the lack of data on maternity care and puerperal sepsis in all the health facilities visited, accurate record keeping should be prioritized as an important strategy to monitor the outcomes of infection control measures. Accurate record keeping should be part of a purposefully designed monitoring and evaluation system for infection control which would allow for regular review and upgrading of activities relating to infection control.

- Regular community engagement through research, public health education and advocacy is needed to highlight the need for women to use clean delivery places for childbirth. This would reduce the current propensity for women to deliver in places (such as at home or with traditional birth attendants) where infection control cannot be guaranteed. It would also encourage all health providers and healthcare institutions to step up their policies and practices relating to infection control and management.

In conclusion, the results of this study demonstrate the lack of appropriate policies and practices relating to infection control in maternity units in Edo state of Nigeria. Given that puerperal sepsis is the third leading cause of maternal mortality in Nigeria, adequate provision for and implementation of infection control programs will significantly reduce maternal mortality. Efforts to promote clean delivery care and reduce infection-related causes of maternal mortality will be one way to provide evidence of national commitment to reducing maternal mortality in Nigeria.

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Table 1: Profile of participating health facilities by LGA

Facility Type	Primary Health cent (PHCs)	Secondary/ District Hosp	Tertiary Hosp	Private Hosp	Total
Egor	0	0	1	11	12
Oredo	4	1	0	14	19
Ovia northeast	6	0	0	2	8
Ikpoba-okha	2	0	0	0	2
Esan north	1	0	0	1	2
Esan Central	2	0	1	7	10
Esan south-west	1	0	0	0	1
Etsako West	1	1	0	7	9
Total	**17**	**2**	**2**	**42**	**63**

Table 2: Infection control procedures and practices reported by the health facilities

	No.	**%**
Standard infection control procedure exists	43	68.3
Form in which control procedure is available:		
Book/Manual	10	15.9
Chart	2	2.3
written	4	6.3
Verbal	27	42.9
Management of infection control:		
Infection control committee exists	8	12.7
Cases of hospital acquired infection in last month	3	4.8
Audit of maternal death reviews	7	11.1

Target set on infection control	18	28.6
Staff training on infection control	21	33.3

Table 3: Details of clean practices or aseptic techniques reported in the health facilities

	No	**%**
All staff routinely wash their hands before procedure	58	92.1
All staff routinely wash their hands after procedure	63	100.0
Soap available at all times for hand washing	63	100.0
Staff vigorously rub hands with antiseptic and/or water	54	85.7
before aseptic procedure such as vaginal examination	59	
HLD/sterile gloves used	58	93.7
Gloves with anti-septic preparation	55	92.1
Gloves worn with non-touch technique	56	87.3
Surgical sites prepared from centre outward with antiseptic	29	88.9
		46.0
Protocol exists for training new staff on infection control	29	

On the job training exists for infection control	59	46.0
Break in sterile field (e.g. torn gloves) is corrected at surgery	55	93.9
Frequency of hand washing is good	60	87.3
Sterility is maintained in vaginal and manual-Procedures	62	95.2
Aseptic precautions are taken for episiotomy care	62	98.4
Patients are advised on infection control	14	98.4
Gloves are re-used		22.2

Table 4: Infection control procedures and practices observed in labour/delivery rooms

Observations:

Items	No	%
Surgical gloves	38	60.3
Surgical gloves: Washed?	7	11.1
Surgical gloves: Reused?	6	9.5
Surgical gloves: Autoclave?	7	11.1
24-hour running water?	33	52.4
Wash basin with elbow or knee tap (aseptic)	33	52.4
Scrub brushes	20	31.7
Soap	41	65.1
Antiseptics for skin preparation	40	63.5
Thermometer	38	60.3
Sterile gloves	41	65.1
Sterile gowns	22	34.9

Sterile gauze	25	39.7
Sterile linen packs	20	31.7
Sterile delivery packs	18	28.6
Disposable delivery kit ("Mama kit")	11	17.5

Table 5: Other observations in labour/delivery suites relevant to infection control.

	No.	**%**
Poster and charts relevant to infection control	9	14.3
Thermometer	33	52.4
Patients' chart showing temperature record	22	34.9
Saw a staff washing hands	17	26.9
Staff washing hands before examining patients	30	47.6
Staff washing hands after examining patients	33	52.4
Staff washing hands before putting hands on gloves	32	50.8
Staff washing hands after taking gloves off	32	50.8

Table 6: Infection control procedures and practices observed in operating theatres.

Items	No	%
24 hour running water	27	42.9
Wash hand basin with elbow or knee tap (aseptic)	27	42.9
Scrub brushes	28	44.4
Soap	31	49.2
Antiseptic for skin preparation	32	50.8
Thermometer	22	34.9
Sterile gloves	29	46.0
Sterile gowns	26	41.3
Sterile gauze	33	52.4
Sterile linen packs	24	38.1
Sterile laparotomy packs	16	25.4
Surgical gloves: Washed?	3	4.8
Surgical gloves: Reused?	1	1.6

Surgical gloves: Autoclave?	3	4.8
Automatic door closure in OT	3	4.8

Table 6: Comparison of international infection control standards and findings of study, using selected indicators

International standards and guidelines*	**Study findings**
Management of an infection prevention programme	
Written policies and procedures established	Available in 25.4% of facilities surveyed
Staff orientation and training	Completed in 33.3%
Conduct of regular reviews	Conducted in 11.1%
Infection control committee	Established in 12.7% facilities surveyed
Asepsis and protection during delivery	
Vigorously rub all areas of hands and fingers together for at least 10-15 seconds	85.7% respondents claim 'vigorous' hand rubbing practised
High-level disinfected or sterile surgical gloves available	69.8% facilities had sterile gloves near labour room
Plastic or rubber apron and face shield (or a mask and goggles) available	69.8% facilities had aprons near labour room
Cleaning, disinfection and sterilisation of equipment	
Soak in chemicals for 20 mins to disinfect or 10-24 hours to sterilise	Soaking in jik for 10-60 mins commonly reported, in many cases time not specified*
Boil or steam for 20 mins to disinfect	Boiling times between 15-60 mins reported. Unclear if instruments steamed or boiled*
Autoclave for up to 30 mins, 106kPas and 121 degrees C to sterilise	Autoclave times of 20-120 minutes reported*
Dry heat for 60 mins at 170 degrees C to sterilise	No reports of dry heat use
Environmental management	
Use air filtration, maintenance of pressure	Fumigation still used in 15.8% of facilities

gradients, air conditioning or good ventilation	surveyed, air conditioner in 42.1% and pressure gradients in 31.7%
Reliable water supply	52.4% facilities surveyed had 24 hour running water

* Sources: Tietjen L, Bossemeyer D, McIntosh N: Infection prevention guidelines for healthcare facilities with limited resources Maryland: JHPIEGO; 2003; World Health Organization: Practical guidelines for infection control in health care. No. 41 III WPRO Regional Publication New Delhi; 2004.
** Combinations of chemical, boiling and autoclaving used.