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CLINICAL ARTICLE

Obstetric quality assurance to reduce maternal and fetal mortality in Kano and Kaduna State hospitals in Nigeria

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ABSTRACT

Objective: To achieve Millennium Development Goals 4 and 5 in Nigeria, a quality assurance project in obstetrics in 10 hospitals in northern Nigeria was established to improve maternal and fetal outcome. *Methods:* The project commenced in January 2008 with assessment and improvement of the structure of the 10 hospitals. Continuous maternal and fetal data collection and analysis were conducted from 2008 to 2009 by means of a maternity record book and structured monthly summary form. The quality of hospital infrastructure and equipment was also assessed. *Results:* The mean maternal mortality ratio (MMR) was reduced from 1790 per 100 000 births in the first half of 2008 to 940 per 100 000 births in the second half of 2009. The average fetal mortality ratio (FMR) decreased slightly from 84.9 to 83.5 per 1000 births. There was an inversely proportional relationship between the total number of deliveries in a hospital and MMR and FMR. There was a close correlation between the MMR and the equipment status and hygiene conditions of the hospitals. *Conclusion:* Continuous monitoring of quality assurance in maternity units raised the awareness of the quality of obstetric performance and improved the quality of care provided, thereby improving MMR.

1. Introduction

Maternal and perinatal mortality is a significant measure of a sufficient obstetric service. Since 1990, both maternal and perinatal mortality have decreased in all European countries, the United States, and Canada to approximately 0.5%–0.6% [1]. At present, maternal and perinatal mortality in Europe is the lowest worldwide, raising the question of which measures have been introduced in the maternal and perinatal healthcare service to achieve this low figure [2,3].

The development of new methods of surveillance of the mother and the fetus before and during labor, in parallel with a move from home deliveries to hospital deliveries and payment for birth costs by insurance companies, has had a major impact on maternal and perinatal mortality. An additional impact has been the introduction of quality assurance in obstetric services for all hospitals [4].

The picture is very different in low-income countries [5]. According to statistics of the WHO [6] and USAID [7], maternal and perinatal mortality remain high in African countries [6]. Ways to improve the quality of care have been outlined by van den Broek and Graham [8], and Dumont et al. [9].

In Nigeria, prenatal attendance is approximately 58%, only 35% of women deliver in health facilities, and most women deliver at home without a skilled attendant [10]. Up to 22% are delivered by traditional birth attendants, and only 42% receive postnatal checkup after delivery [10]. It is therefore not surprising that the National Demographic Health Service (NDHS) of Nigeria has recorded a maternal mortality ratio (MMR) of 545 per 100 000 live births [10], although this figure varies tremendously. The average MMR estimated by WHO, UNICEF, UNFPA, and the World Bank is 820, with a range of 460 to 1500. The NDHS also recorded an infant mortality rate of 75 per 1000 live births and an under-5-years mortality rate of 157 per 1000 live births. The quality of care provided by most maternity centers in Nigeria is poor; as a result, utilization of the services is still insufficient despite the provision of free maternity care in some states.

Against this background and as part of the Millennium Development Goals 4 and 5, Rotary International, supported by the German Federal Ministry of Economic Cooperation and Development in collaboration with the governments of Kano and Kaduna States, introduced a project of quality assurance in obstetric services in 10 hospitals located in northern Nigeria, where MMR is reported to be extremely high [10].

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The basic principles of quality assurance in a hospital are based on 3 parameters: "quality of infrastructure," "quality of process," and "quality of outcome." All 3 parameters are interdependent and closely related. Quality of infrastructure comprises the conditions of the hospital building, including water supply, power supply, hygiene conditions, number of staff, and equipment available. Quality of process is predominantly dependent on a sufficient infrastructure, but also on trained, skilled, and experienced health personnel. By contrast, quality of outcome is dependent on both the quality of infrastructure and the quality of process and can be evaluated by continuous data monitoring. The circle of quality is a continuous and interrelated process and has an inherent ability to lead to a spiral improvement of the system (Fig. 1).

The aim of the present study was to assess the 2-year results of an ongoing total quality assurance project in 10 Nigerian hospitals in a rural setting, and their impact on the MMR and fetal mortality ratio (FMR) in these hospitals from 2008 to 2009.

2. Materials and methods

Ten rural hospitals in the northern states of Kano and Kaduna (5 from each) were selected in agreement with, and on the proposals of, government officials for the present project of quality assurance. The hospitals participated under the supervision of the Aminu Kano Teaching Hospital (AKTH), Kano and Ahmadu Bello University Teaching Hospital (ABUTH), Zaria. To guarantee confidentiality, each hospital received a coded number by which they could identify themselves but not the other hospitals. This is an important instrument of benchmarking in order to improve the results and encourage honest criticism.

For uniform data collection, a maternity record book was developed and tested in 2007 and used by all hospitals. It records 16 obstetric values, such as age of patient, parity, gestational age, mode of delivery, complications at delivery and/or postpartum, birth weight, and Apgar score of baby. These data are routinely collected for all deliveries by midwives in the participating hospitals. For the quality assurance project, a monthly form was completed that summarized the obstetric data for the month, such as total prenatal clinic attendance, total deliveries, total cesarean deliveries, total cases of eclampsia, and total maternal and fetal deaths. The monthly summary forms were checked, monitored, and collected monthly by the chief midwife.

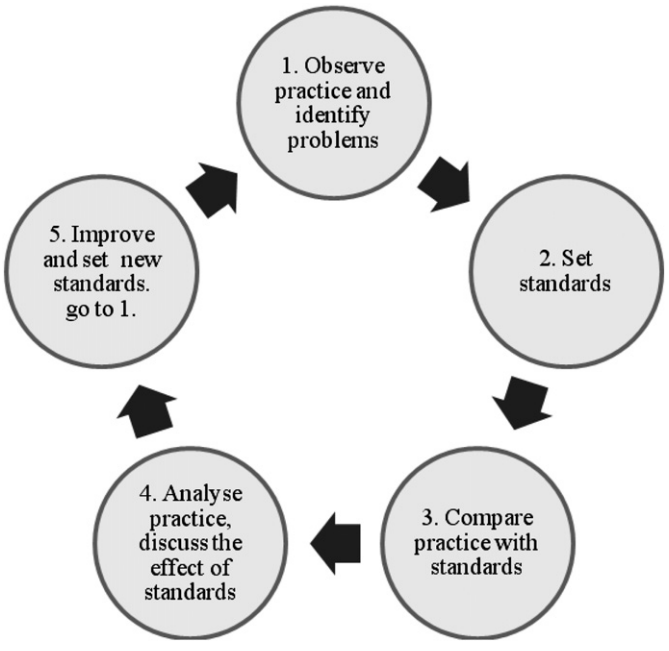

Fig. 1. Circle of quality assurance, demonstrating a cycle of continuous improvement via the introduction of standards, collection of data, and discussion of results.

Local standards for infrastructure status (IS) and hygiene status (HS) were not available. Most of the hospitals were in a dreadful condition that was hard to evaluate. As a result, the quality of the infrastructure of the 10 hospitals was evaluated via a structured questionnaire (Table 1). For each hospital, score criteria for the "general status of the infrastructure/equipment" and score criteria for "hygiene conditions" were used. Each of 5 areas (units)—operating theater, delivery room, neonatal unit, delivery ward/prenatal clinic, and general conditions of the hospital—was scored by 2 investigators by evaluating different criteria within each area from 1 (excellent, best result) to 6 (very poor, worst result).

For the operating theater unit, 12 criteria were evaluated for both IS and HS; for the delivery room unit, 8 criteria were evaluated for both IS and HS; for the neonatal unit unit, 3 criteria were evaluated for both IS and HS; for the delivery ward and prenatal clinic unit, 7 criteria were evaluated for both IS and HS; and, for the general hospital condition unit, 7 criteria were evaluated for both IS and HS. This provided a simple method for defining the impression of the facility in numbers.

According to the points given for each unit, the total score for general infrastructure/equipment ranged from a minimum of 5 points to a maximum of 30 points, for hygiene conditions from 5 to 30 points, and in total from 10 (best result) to 60 (worst result) points. The

Table 1
Evaluation criteria for infrastructure and hygiene conditions in the 10 study hospitals.

Score criteria for infrastructure/equipment	Score criteria for hygiene
Operating theater	
Anesthesia apparatus	Condition of floor
Operating table	Cleanliness of sink
Resuscitation equipment	Cleanliness of apparatus
Instruments for operations	Dust distribution
Intubation set	Blood-stained equipment
Suction machine	Cleanliness of resuscitation equipment
Anti-shock garments	Filled suction machines
Oxygen availability	Sterilizing condition
Bag valve mask	Blood-stained walls
Cesarean section set	Availability of operating shoes
Theater lamp	Unorganized storage of material
Sterilizer	Cleanliness of record books
Delivery room	
Delivery beds	Dust distribution
Delivery instruments	Blood-stained delivery beds
Specula	Rusted instruments
Vacuum extractor	Rusted delivery beds
Episiotomy set	Conditions of bowls for sterilizing
Delivery set	Conditions of mattresses
Baby scale	Hand disinfection
Gloves	Resuscitation units for newborns
Neonatal unit	
Incubator	Dust distribution
Instruments for intubation/resuscitation	Rusted instruments
Baby scale	Conditions of mattresses
Delivery ward/prenatal clinic	
Number of beds	Conditions of beds
Drip system	Dust-stained mattresses
Mosquito nets	Condition of floor
Maternity record book	Availability of mosquito nets
Ultrasound scanning room	Cleanliness of ultrasound probes
Mother scales	Dust-stained instruments
Sphygmomanometer	Dust-stained windows
General conditions	
Water supply, bore hole	Sink hygiene
Electricity (power supply)	Toilet hygiene
Window form and good seal	Cobwebs
Generator	Gloves
Refrigerator	Aprons
Magnesium sulfate	Masks
Blood bank availability	Storage of files

scores were used to obtain a comprehensive impression of each hospital and to identify the relationship between maternal mortality as the worst outcome of infrastructure and the score for each hospital.

The quality of process was improved by training healthcare workers from the 10 hospitals on emergency obstetric care—in particular, the use of magnesium sulfate for managing eclampsia, and the treatment of postpartum hemorrhage (PPH), including use of an anti-shock garment. However, evaluation of this is based on only the improvement post-test because there were no pre-training data available for comparison.

All data collected from the summary forms were collated and analyzed via Excel (Microsoft, Redmond, WA, USA). A statistician was trained at AKTH under the supervision of a senior consultant at the Department of Obstetrics and Gynaecology. The aim was to establish an "Institute of Quality Assurance" at AKTH, which would oversee the data collection and analysis of all hospitals, and feed back the results to the participating hospitals in a blind way. The hospitals would then have the opportunity to compare their own results with those of the other hospitals. This flow of data from the hospitals to the institute and back to the hospitals is an essential step in the quality assurance circle (Fig. 2).

Review meetings were held with the aim of inducing competition among the hospitals. The outcome parameter was MMR, and FMR was also a strong parameter. The quality circle (Fig. 1) starts with observation of a practice or identification of problems, sets standards to reduce maternal mortality as the ultimate outcome, compares practice with these standards, and then analyzes the effect of the practice on outcome (maternal mortality). Regular review meetings with representatives (usually a lead doctor and midwife) of each hospital were carried out at half-year intervals in a benchmarking process to discuss the anonymous data that had been collected and evaluated. At these meetings, major problems observed from the data collection and at hospital visits were addressed.

3. Results

A total of 29833 deliveries were analyzed in the 2 study years of 2008 and 2009.The total number of deliveries varied among the study hospitals: 250 was the lowest number of deliveries in a hospital, and 1500 was the highest in a half-year (6-month) period (Fig. 3A).

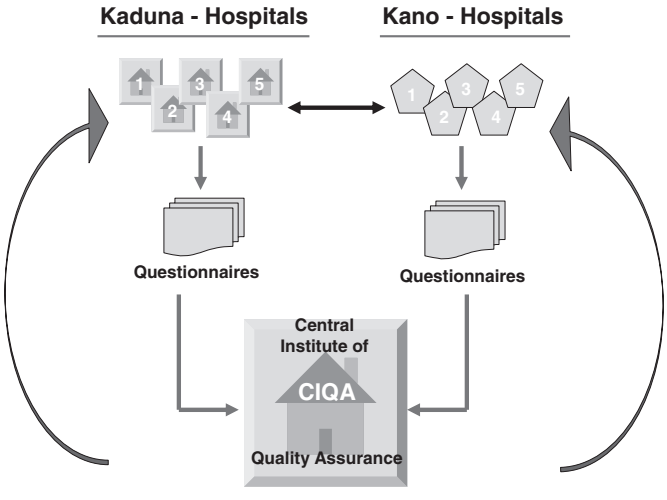

Fig. 2. The ongoing process of data collection from the 10 participating hospitals and the Institute of Quality Assurance at Aminu Kano Teaching Hospital. Obstetric data are collected monthly from the uniform maternity record book via questionnaires sent to the respective hospitals in Kaduna and Kano, and evaluated by the Central Institute of Quality Assurance. All of the evaluated data are then given to each hospital. Hospital managers, doctors, and midwifes can identify their hospital by the hospital code and compare their results with those of the others. These results form the basis for discussion at the half-yearly review meetings.

Table 2 shows the incidence of MMR, FMR, cesarean delivery, eclampsia, and PPH in the 10 hospitals in 2008 and 2009. A maternal death was considered as a death of the mother after admission in pregnancy, labor, or after delivery, but before discharge from the hospital. There was a significant reduction in the average MMR from 1790 per 100 000 births in the first half of 2008 to 940 per 100 000 births in the second half of 2009 (Fig. 3B). Hospital MMR also decreased steadily over the study period, ranging from 100 to 6000 per 100 000 births in the first half of 2008, but from 100 to 1500 per 100 000 births in the second half of 2009. However, MMR showed a wide variation over the period of observation. Hospital MMR was strongly related to and dependent on the number of deliveries in the hospitals (Fig. 4). Hospitals with high delivery rates had a lower MMR than hospitals with low delivery rates.

The FMR also showed marked variation among the hospitals. It ranged from 4% to more than 20%. It is evident that FMR is also associated with the number of deliveries in a hospital; for example, hospitals with low delivery rates had the highest FMR (Fig. 5). Overall, there was a close relationship between maternal mortality and fetal mortality, with FMR increasing with MMR. However, there was a wide variance among the hospitals, where high FMR was not associated with high MMR.

The frequency of cesarean delivery decreased during the 2 study years, and ranged from 2.8% to 12.3% in 2009. There was, however, a big variation in cesarean rates over the 2 study years, and also among the hospitals during this time. Contrary to expectations, FMR increased with the number of cesarean deliveries (Fig. 6). This may be because cesareans are performed mainly to save the life of the mother.

The incidence of eclampsia did not change over the study period, ranging from 7.04% to 10.12%. There was, however, a tendency toward

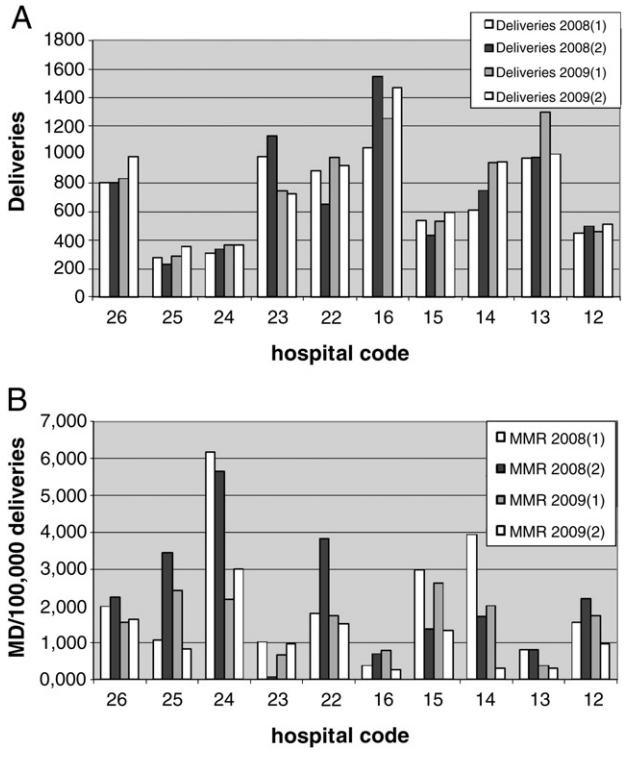

Fig. 3. Number of deliveries and maternal mortality ratio (MMR) in the study hospitals. A Number of deliveries in 2008 and 2009. The number of deliveries is shown at half-yearly intervals for each hospital indicated by its code, which guaranteed confidentiality of the data collected. The hospitals showed considerable variation in deliveries. B MMR from the first half of 2008 to the second half of 2009. The MMR is shown at half-yearly intervals for each hospital, indicated by its code. In 8 hospitals, a continuous fall in maternal mortality was observed (26, 25, 24, 22, 15, 14, 13, and 12). In 2 hospitals, the MMR was below 1000 per 100 000 deliveries and remained unchanged (23, 16).

Table 2
Half-yearly observations of deliveries in the 10 study hospitals.

	No. of deliveries	Cesarean	MMR No. (per 100 000 deliveries)	FMR	Eclampsia	PPH
January–June 2008	6878	494 (7.2)	123 (1.790)	584 (8.5)	484 (7.0)	301 (4.4)
July–December 2008	7369	451 (6.1)	120 (1.630)	653 (8.9)	490 (6.7)	333 (4.5)
January–June 2009	7695	457 (5.9)	106 (1.380)	750 (9.8)	779 (10.1)	255 (3.3)
July–December 2009	7891	369 (4.7)	74 (940)	659 (8.4)	776 (9.8)	394 (5.0)
Total 2008 and 2009	29833	1771 (5.9)	423 (1.240)	2646 (8.9)	2529 (8.8)	1283 (4.3)

Abbreviations: FMR, fetal mortality ratio; MMR, maternal mortality ratio; PPH, postpartum hemorrhage.
[a] Values are given as number (percentage) unless otherwise indicated.

a higher incidence in hospitals with a lower number of deliveries. Similar observations were made for PPH. Although PPH did not show a close association with MMR, it showed a higher incidence in hospitals with a lower delivery rate.

By using the score criteria for assessing the quality of hospital structure in terms of infrastructure/equipment conditions and hygiene conditions of the theater, delivery room, neonatal unit, and prenatal clinic, hospitals with the lowest score of 20–40 had the lowest MMR of approximately 500 maternal deaths per 100 000 births, and hospitals with the highest score of about 45–50 had the highest MMR of 2000 maternal deaths per 100 000 births in the year 2009 (Fig. 7). This clearly illustrates that the hospitals with better quality of infrastructure had a better MMR and those with poor quality of structure had a poorer MMR.

An assessment of the clinical data was feasible by comparing the statistical evaluation of the data to the total data pool among the hospitals participating in the study (Table 3). Although it is interesting to look at different variables, such as the number of twin deliveries, breech deliveries, cesarean deliveries, vacuum extractions, and severe diseases such as eclampsia/pre-eclampsia and PPH, of chief importance is the benchmarking of maternal and fetal mortality and their relation to the other parameters (Table 3).

In the ongoing quality assurance project, the hospital with the lowest MMR is considered to be the "leading hospital," and is used as the reference hospital. It has the highest number of prenatal clinic visits and follow-ups, a high number of deliveries, a medium number

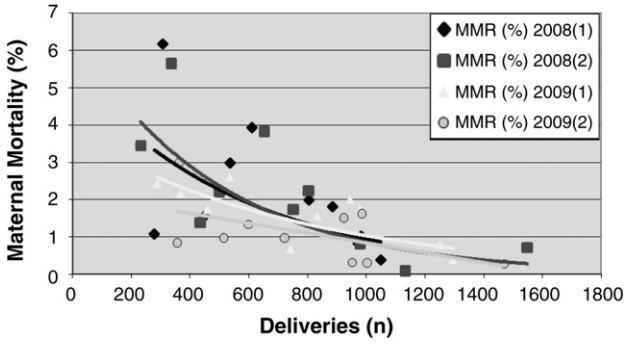

Fig. 4. Relationship between the number of deliveries in the study hospitals and maternal mortality ratio (MMR). Of significance, the smaller hospitals experienced a higher MMR. Also seen, however, is a steady decrease in MMR over the 2 study years from dark blue (1/2008) to light blue (2/2009).

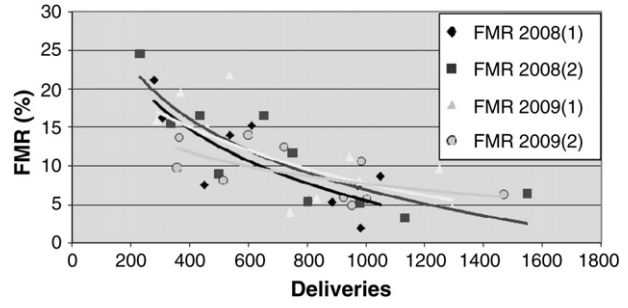

Fig. 5. Relationship between the number of deliveries in the study hospitals and fetal mortality ratio (FMR). Notably, the smaller hospitals with a low number of deliveries had the highest FMR. There was no major change in fetal mortality over the 2 study years (see correlation curves).

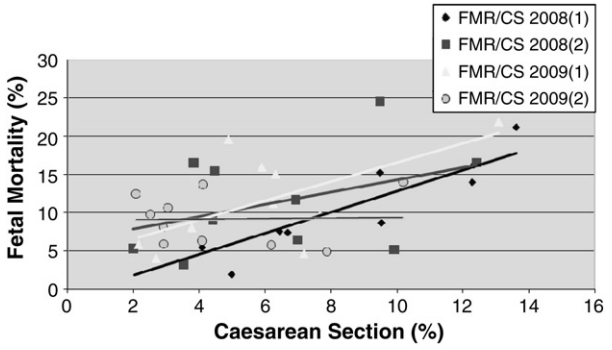

Fig. 6. Relationship between the frequency of cesarean delivery in the study hospitals and fetal mortality ratio (FMR). Paradoxically, FMR rose with an increasing frequency of cesarean delivery. In the second half of 2009, however, FMR remained constant as the frequency of cesarean delivery increased.

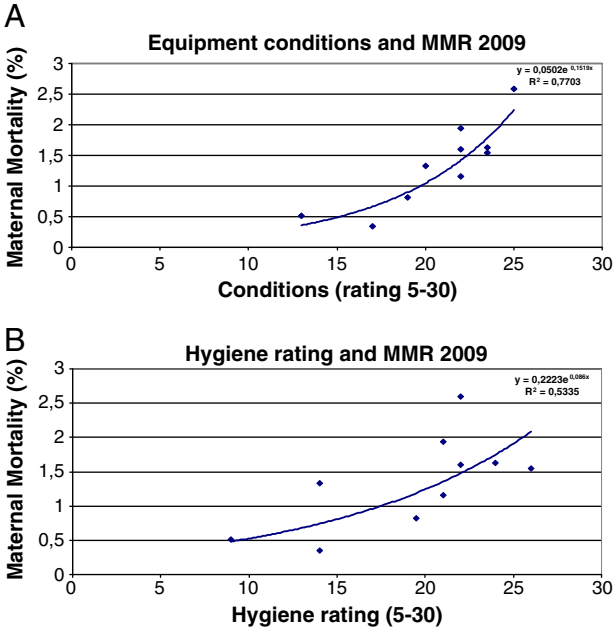

Fig. 7. Relationship between MMR and the infrastructure and hygiene conditions of the 10 study hospitals. A Relationship between the score for hospital infrastructure/equipment and MMR. B Relationship between the score for hospital hygiene and MMR.

Table 3
Clinical profile of the 10 study hospitals.

Clinical profile	Median	Range [a]	Reference hospital [b]
Prenatal clinic, number of visits	3284	1999–9684	9684
Prenatal clinic follow-up/number of visits	6584	2999–18208	16824
Number of deliveries	1362	511–2597	2155
Twin deliveries, %	2.20	1.1–4.0	1.7
Breech delivery, %	2.23	1.0 –3.8	1.6
Cesarean delivery, %	8.0	2.8–12.3	4.2
Vacuum extraction, %	0	0–3.1	0.0
Eclampsia/pre-eclampsia, %	6.1	1.8–30.5	1.8
Postpartum hemorrhage, %	4.5	1.8–22.3	5.3
Maternal mortality, %	2.1	0.5–5.9	0.5
Fetal mortality, %	8.3	2.7–22.7	2.6

[a] The minimum and maximum values of the various indicators is given for each participating hospital.
[b] The reference hospital was the hospital with the lowest maternal mortality ratio.

of cesarean deliveries, and only a few cases of eclampsia and PPH. The FMR is also low. From this comparison of the median and range values, conclusions can be drawn with regard to obstetric management in that hospital and the other hospitals. It should be noted that the data collected were cumulative data rather than individual data analyses; such analyses remain a challenge in most of the participating hospitals at present.

4. Discussion

Maternal mortality and child mortality in Nigeria are among the highest worldwide. According to national statistics, the MMR was 800 per 100 000 deliveries in 2005 [11], although a more recent NDHS survey in 2008 [10] has shown a decrease to 545 per 100 000 live births. MMR is much higher in the northern states of Nigeria [11,12]: the northeast zone has the highest MMR of 1549 per 100 000 live births as compared with 165 per 100 000 live births in the southwest zone [13].

According to the latest systematic review by Hogan et al. [14], many interventions to reduce MMR have failed. Family planning methods have not shown the expected effect, and the treatment of isolated, singular complications during pregnancy and labor has not been successful. As a result, a new approach is needed to tackle the high MMR, as proposed by numerous research groups [14–17].

According to experience in European countries [4], high MMR and FMR are, in general, the result of problems in (1) awareness, (2) organization of healthcare, (3) infrastructure of hospitals, and (4) quality of process in healthcare systems (i.e. hospitals should be staffed with skilled medical personnel and should be based on a good infrastructure) [3,4,18–20]. In previous studies, tackling the causes of maternal mortality has focused mainly on describing the causes, rather than on sustainable intervention, of the problem. The present study describes a successful intervention targeting the third problem—infrastructure of the hospitals—and has addressed the issue of how to reduce maternal mortality in 10 hospitals in Kano and Kaduna States in northern Nigeria by comparative quality assurance (benchmarking) and systematic improvements in quality.

In 2000, a WHO report showed that the MMR of a country is closely correlated to the quality of healthcare in that country [21]. "Quality of healthcare" is used here in its holistic sense, not just as a measure of the best that the country can provide in its large teaching hospitals but also of how effectively good-quality healthcare reaches the country's poorest people in rural areas. Therefore, it was not surprising that introducing quality assurance in the 10 study hospitals led to a marked decrease in MMR, with the average MMR falling from 1790 per 100 000 deliveries in the first half of 2008 to 940 per 100 000 deliveries in the last half of 2009. Individual hospitals also demonstrated a marked decrease in MMR (Fig. 3B).

The present project improved the quality of obstetric service by improving the quality of process, for example, by introducing protocols for management of obstetric complications. These protocols included use of magnesium sulfate for management of eclampsia, active management of the third stage of labor for preventing PPH, and use of the partograph for managing labor. These procedures are in line with the recommendations of a South African confidential enquiry into maternal death, which emphasized the pivotal role of health services in reducing MMR [22].

The present project also demonstrated that hospitals with a high number of deliveries have a lower MMR and vice versa. This is because utilization of maternity services is related to the quality of care provided in a health facility, as shown in Zimbabwe [23]. The pattern of utilization of maternity services by rural women has been shown to be based on rational decision-making, which takes into account not only the distance to a service but also whether the care provided is considered to be of good quality [24]. Hence, the low quality of care offered in maternity clinics contributes to the low utilization of the service. The FMR was also lower in hospitals with a high number of deliveries (Fig. 5); however, the FMR was shown to rise with increasing frequency of cesarean section. A possible explanation for this unusual finding might be that cesarean is often done after the fetus is dead in order to save the life of the mother.

The present project demonstrates that without improvements in the quality of the infrastructure of health facilities, such as hygiene and equipment, all maternal health interventions will have a minimal impact on maternal health statistics (Fig. 7). Hospitals with low scores and better quality of infrastructure have a lower MMR. The half-yearly review meetings, in which the collated and analyzed data of the 10 hospitals (coded) are discussed, have been extremely useful in improving the quality of healthcare services provided in the hospitals. Continuous improvement of obstetric practice will be achieved by this circle of activities [24], which also provides an avenue for useful criticism and opportunity for an individual hospital to assess itself among other hospitals. This also encourages competition by benchmarking. When fully established, the Institute of Quality Assurance will continue to oversee the continuous collection and analysis of obstetric care data.

Securing women's health is a comprehensive issue and has remained a constant challenge since described by Fathalla in 1994 [25]. Those of us who are trying to reduce maternal mortality from a medical perspective will be unable to achieve fundamental change without a massive improvement in the quality of healthcare services that we provide in our health facilities. In this context, governments play a key role in rural areas by providing the necessary skilled staff and equipment, and thereby improving the quality of care in the health facilities. The present study has shown that applying quality assurance measures in rural hospitals can improve maternal health.

Conflict of interest

The authors have no conflicts of interest.

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