

## AOGS MAIN RESEARCH ARTICLE

# Training health workers for magnesium sulfate use reduces case fatality from eclampsia: results from a multicenter trial

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## Key words

Eclampsia, maternal mortality, case management, magnesium sulfate, case fatality rate

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## Conflict of interest

The authors declare no conflict of interest.

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## Introduction

Available data indicate that eclampsia is the second leading cause of maternal mortality in Nigeria, accounting for more than 20% of maternal deaths (1–3). Reports from several hospitals in the country also suggest high case

## Abstract

**Objective.** To investigate the effectiveness of an intervention aimed at improving the case management of eclampsia. **Design.** A multi-center intervention study. **Setting.** Six teaching hospitals in Nigeria. **Sample.** Clinical records of cases of eclampsia treated before and 1 year after the intervention. **Methods.** Doctors and midwives in selected hospitals were re-trained to manage eclampsia using magnesium sulfate according to the Pritchard protocol. **Main outcome measures.** Eclampsia case fatality rates, maternal and perinatal mortality rates before and after the intervention. **Results.** A total of 219 cases of eclampsia were managed over a 12-month period. There were seven maternal deaths. The post intervention case fatality rate of 3.2% was significantly less than the pre-intervention rate of 15.1% ( $p < 0.001$ ). The overall maternal and perinatal mortality ratios and rates respectively in the hospitals declined from 1199.2 to 954 per 100 000 deliveries and 141.5 to 129.8 per 1000 births, respectively ( $p > 0.05$ ). **Conclusion.** An intervention to build the capacity of care-providers to use an evidence-based protocol for the treatment of eclampsia in Nigeria was successful in reducing associated case fatality rate. The increased and widespread use of such an intervention in maternity units might contribute to the reduction of maternal mortality in low-income countries.

**Abbreviations:** CFR, case fatality rate; MMR, maternal mortality ratio; PNMR, perinatal mortality rate.

## Key Message

Building the capacity of healthcare providers to use magnesium sulfate for the treatment of eclampsia is an effective intervention for reducing the number of deaths due to eclampsia in low-income countries.

fatality rates (CFR) associated with the disease. In northern Nigeria, eclampsia accounts for only 4% of all obstetric emergencies (4) but for up to 45% of maternal mortality (5).

The high CFR associated with eclampsia in Nigeria is attributable to its poor clinical management in healthcare institutions. Several reports indicate that many Nigerian clinicians still use drugs such as diazepam, lytic cocktail and clomethiazole (Heminevrin) as regimens for the treatment of eclampsia (6,7), rather than more effective protocols. By contrast, magnesium sulfate, which is currently the recommended drug for the treatment of eclampsia worldwide (8,9), has found limited use in Nigeria. Several Nigerian centers participated in the Magpie trial (10) that showed a reduction in the risk of eclampsia by 50% in the treatment group compared with the placebo group of women with pre-eclampsia. However, to date, few reports on its routine use have been documented in the country (11–13). The eclampsia trial (14) has also demonstrated that magnesium sulfate is superior to diazepam and phenytoin for preventing recurrent seizures in women who have already had seizures. Many of the reports on the use of magnesium sulfate for the management of eclampsia from Nigeria have been small, retrospectively obtained case-series data.

Magnesium sulfate was included in Nigeria's Essential Drug List for the treatment of eclampsia in 2009 (15). However, its use is yet to be institutionalized or scaled up in the country (16) because of multiple factors including its relative non-availability (17), limited clinician experience in its use, and the persisting misconception about its toxicity in the absence of facilities to monitor serum magnesium levels (18). However, recent evidence indicating that magnesium sulfate can be used in resource-constrained settings without the need for intensive care (19) has stimulated interest in the use of the drug in the country.

In 2008, the Society of Gynecology and Obstetrics of Nigeria (SOGON) began a pilot project aimed at building the capacity of providers to properly administer magnesium sulfate for the treatment of eclampsia. Formative research was conducted to determine the need for emergency obstetric care and to identify strategies for reducing maternal mortality in the hospitals. Existing clinical records on trends in maternal mortality, the major obstetric causes of maternal mortality and the quality of treatment of eclampsia were examined. The needs assessment report (20) revealed high maternal mortality ratios (MMR) in the hospitals, with eclampsia, primary postpartum hemorrhage and puerperal sepsis being the leading causes of mortality. Eclampsia was associated with high CFRs, ranging from 5.6 to 27.2%, with each hospital revealing the inconsistent use of evidence-based protocols

for the management of eclampsia. None of the hospitals routinely used magnesium sulfate for the treatment of eclampsia. For these reasons, we decided to re-train the doctors and midwives in the participating hospitals on use of magnesium sulfate for the management of eclampsia. The objective of this article is to report the results of this project and its effects on associated case fatality rates and maternal and perinatal mortality rates in the hospitals.

## Material and methods

The project was implemented in six tertiary hospitals in Nigeria: Aminu Kano Teaching Hospital; Lagos State University Teaching Hospital; the University of Calabar Teaching Hospital; University of Jos Teaching Hospital; University of Maiduguri Teaching Hospital; and the University of Nigeria Teaching Hospital.

Formative research was conducted in January–May 2008 to collect baseline data. This consisted of review of hospital records and in-depth interviews with health providers to explore their knowledge and experiences in using appropriate protocols for the management of eclampsia as previously described (20). Using the results of the needs assessment, a training curriculum was developed and validated through a series of technical meetings. The curriculum was finalized in March, 2009. Subsequently, the training workshops were held simultaneously in the hospitals between April and June 2009. The training consisted of reviews of the epidemiology of maternal mortality, description of the clinical features of eclampsia, identifying ways to overcome the limitations of the healthcare system in managing eclampsia, the importance of quality of care, and a review of protocols based on treatment with magnesium sulfate. Attendance at the workshops was mandatory for staff and lasted 3 days. It included presentations, demonstrations, discussions and role plays (based on multi-professional simulation training). Participants included consultant obstetricians and gynecologists, resident doctors in training, attending nurse/midwives, nurse/midwives in training and staff from related departments (laboratory, pharmacy, anesthetists and pediatrics) as well as senior management staff who provide supportive services for the management of eclampsia in the hospitals. Staff participation rates ranged from 80 to 95% in the different hospitals. Non-participation was often due to the need for staff to provide emergency services at the time of the training.

The data collection questionnaires were developed and prepared in June–July 2009, and the intervention commenced on 1 August 2009. This consisted of the use of magnesium sulfate for the treatment of eclampsia based on the Pritchard's protocol (21) and the

recommendations of the Federal Ministry of Health (15). Magnesium sulfate was obtained from registered suppliers (Clampex®; Fidson Healthcare, Lagos, Nigeria) and provided for use in the hospitals. Guidelines were also provided for the rational and timely use of anti-hypertensive drugs, the close monitoring of the mother and the fetus, and decision-making on the appropriate mode of delivery after the woman had been stabilized. All women experiencing eclampsia as evidenced by the presence of tonic-clonic convulsions, hypertension and proteinuria, with or without edema (including those referred from other maternity centers) were included in the study. Women receiving treatment with magnesium sulfate were monitored using clinical parameters: the presence of knee jerk reflex, respiratory rate >15 cycles/min and urine output >25 mL/min, as described by Tukur (22). For each woman, a case record form was used to record clinical outcomes of interest. Approval for the study was obtained not only from each center's Ethics Review Committee but also from the Ethical Review Board of the Women's Health and Action Research Center, Benin City, Nigeria (Ref: WHARC/ERB/2009/02/05).

In calculating sample size, it was determined that a clinically significant effect of 10% reduction in CFR or more over 12 months would be of interest. Assuming a survival rate of 60% among those who would have died, with a significance of 0.05 and a power of 0.8, it was established that a minimum sample size of 132 women would be required. However, a total of 219 eclamptic women were recruited during the first 12 months of the intervention (1 August 2009–31 July 2010) and all were included in the sample. Data were compared with baseline statistics on associated CFR and MMR and perinatal mortality rate (PNMR) in the hospitals obtained from the formative research that preceded the intervention, and were also compared with national statistics. Chi-squared test (with Yates correction) was used to compare data with the level of significance set at  $p < 0.05$ .

## Results

The results of pre-tests and post-tests conducted during the workshop showed significant increases in knowledge scores relating to the management of eclampsia among all categories of participating care providers. As an example, the percentage of participants correctly reporting dosage of magnesium sulfate for treatment using the Pritchard protocol increased from 15 to 95% among consultant obstetricians and gynecologists; from 20 to 100% among trainee doctors; and from 2.5 to 60% among nurse/midwives, who participated in the training workshops. Data from a total number of 219 cases of eclampsia had been collated during the 12 months of inclusion. The socio-

**Table 1.** Socio-demographic and clinical characteristics of women treated for eclampsia.

Number of women	219
Pregnancy duration (median and range) weeks	35 (20–43)
Incidence of eclampsia at baseline study (number/total deliveries)	265/17 204 (1.5%)
Incidence of eclampsia at intervention (number/total deliveries)	219/15 964 (1.4%)
Age of eclamptic women (median and range) years	24 (14–40)
Parity distribution of pregnant women <i>n</i> (%)	
Nulliparous	118 (53.9)
Para 1–5	89 (40.6)
>Para 5	12 (5.5)
Method of delivery in eclamptic women, <i>n</i> (%)	
Vaginal delivery	120 (54.8)
Caesarean section	85 (38.8)
Vacuum/Forceps delivery	2 (0.9)
Born before arrival in hospital	12 (5.5)

demographic characteristics of the women are presented in Table 1. The women ranged in age from 14 to 40 years (median 24 years), with parity distribution indicating that nearly 54% were nulliparous. The women presented at gestational ages ranging from 20 to 43 weeks (median 35 weeks). There was no significant difference between the six study sites in the median gestational ages at which the women first presented at the hospital. Overall, 29.6% of women presented during the pre-term period (<37 weeks of gestation). Nearly 55% of the women delivered vaginally, whereas 38.8% were delivered by emergency caesarean section. Total days of hospitalization ranged from 1 to 19 days.

The outcomes of the clinical management of the women are presented in Table 2. There were seven maternal deaths representing an overall CFR of 3.2% (3200 per 100 000). A closer look at the data indicated that six women who died had not received antenatal care, and

**Table 2.** Overall maternal, perinatal and fetal outcomes before and after the intervention.

	Before intervention	After intervention	<i>p</i> -values
Eclampsia case fatality rate, %	15.1	3.2	<0.001
Overall maternal mortality rate/100 000 deliveries	1199.2	965	0.49
Overall perinatal mortality rate/1000 deliveries	141.5	129.8	0.32
Birthweight, median (range), g	N/A	3000 (700–4400)	–
Incidence of low birthweight, % (< 2500 g)	N/A	13.5	–

N/A, data not available.

had been brought from churches and their homes where they had intended to deliver. These women were admitted in late labor with severe complications and irreversible organ damage. By contrast, four women experienced severe near-miss obstetric complications; hypertensive stroke (one woman), acute renal failure necessitating dialysis (one woman), placental abruption (one woman) and primary postpartum hemorrhage necessitating blood transfusion (one woman), but all survived after treatment. Birthweight ranged from 700 to 4400 g (median 3000 g). As shown in Table 2, the associated overall PNMR was 12.9%.

A comparison of the CFR, MMR and PNMR before and after the intervention is presented in Table 2. The overall CFR declined from 15.1% before the intervention to 3.2% after the intervention. The difference was significant ( $p < 0.001$ ). The overall MMR declined in the hospitals from 1199.2 to 954 per 100 000, but the decline was not significant ( $p = 0.49$ ). Regarding PNMR, there was a non-significant decline in the hospitals from 141.5 to 129.8 per 1000 births after the intervention ( $p = 0.32$ ).

## Discussion

This study was designed to evaluate the effects of training clinicians and midwives to use magnesium sulfate for the treatment of eclampsia on CFR associated with the disease. Our results showed a significant reduction in CFR from eclampsia with no significant change in the overall MMR and PNMR. Although the Aminu Kano University Teaching Hospital enlisted in this study had participated in the Magpie trial, they had not institutionalized the use of magnesium sulfate for the management of eclampsia for logistic reasons (including lack of drug supplies) and the inadequate development of guidelines and protocols for its use. We believe that the reduction in CFR in this study is principally the result of the intervention on account of the high level of monitoring, the skills building of healthcare workers and the intensified use of evidence-based protocols and guidelines. In a criteria-based audit of the management of eclampsia conducted in a tertiary hospital in Dar Es Salaam, Kidanto *et al.* (23) reported a high CFR of 7.7% mainly due to use of poor management guidelines and inadequate monitoring of women, with two-thirds of women scheduled for caesarean section not undergoing the procedure at the scheduled time. They recommended the use of standardized guidelines, greater involvement of specialists, and continued medical education on current management of eclampsia for junior staff to improve the quality of care and decrease CFR. Based on reviews of studies conducted in Mexico and Thailand, Lumbiganon *et al.* (24) have also recommended the development and implementation

of local treatment protocols and the training of healthcare workers in the use of magnesium sulfate.

Thus, the significant decline in CFR from eclampsia following these interventions emphasizes the importance of continuing education among clinicians in low-income countries to improve the management of serious obstetric emergencies such as eclampsia. As clinical practice often lags behind current knowledge, the findings in this study suggest that such continuing education and interventions need to be undertaken on an on-going basis in efforts to reduce the high maternal mortality rate associated with obstetric complications. Judging from the non-significant decline in the overall MMR and PNMR in this study despite the decreased CFR from eclampsia, it is evident that for this approach to be effective in reducing MMR, interventions for improving quality of care must be carried out for all causes of maternal mortality simultaneously. Intervention research is needed to determine how to scale up the provision of improved quality of care for major obstetric complications that lead to high rates of maternal mortality in low-income countries. There may also be the need for regular repetition of clinicians' re-training sessions and reviews of existing protocols and guidelines.

A major concern of this study has been how to sustain the provision of improved quality of care for the management of eclampsia in the hospitals beyond the period of the intervention. The routine treatment protocols that have been put in place would be highly useful in consolidating clinicians' knowledge and practice, while efforts should be made to carry out regular clinical and criteria-based maternity audits to ensure compliance with the protocols. Furthermore, the involvement of the hospital administrators in the training workshops and the follow-up interventions would ensure the continued supply and re-stocking of magnesium sulfate as an essential emergency drug in the hospitals. Continued advocacy to hospital administrators and relevant policymakers will be helpful in ensuring that the gains of the project are sustained over time.

We conclude that capacity building on use of magnesium sulfate resulted in a significant decline in associated CFR from eclampsia in six Nigerian hospitals. The re-training of clinicians on use of evidence-based protocols for improving the quality of care for major obstetric emergencies is an important strategy to reduce the high ratios of maternal mortality in low-income countries.

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