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Clinical practice patterns on the use of magnesium sulphate for treatment of pre-eclampsia and eclampsia: a multi-country survey

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Objective To characterise the current clinical practice patterns regarding the use of magnesium sulphate ($MgSO_4$) for eclampsia prevention and treatment in a multi-country network of health facilities and compare with international recommendations.

Design Cross-sectional survey.

Setting A total of 147 health facilities in 15 countries across Africa, Latin America and Asia.

Population Heads of obstetric departments or maternity units.

Methods Anonymous online and paper-based survey conducted in 2015.

Main outcome measures Availability and use of $MgSO_4$; availability of a formal clinical protocol for $MgSO_4$ administration; and $MgSO_4$ dosing regimens for eclampsia prevention and treatment.

Results Magnesium sulphate and a formal protocol for its administration were reported to be always available in 87.4% and 86.4% of all facilities, respectively. $MgSO_4$ was used for the treatment of mild pre-eclampsia, severe pre-eclampsia and eclampsia in 24.3%, 93.5% and 96.4% of all facilities, respectively. Regarding the treatment of severe pre-eclampsia, 26.4% and 7.0% of all facilities reported using dosing regimens that were consistent with Zuspan and Pritchard regimens, respectively. Across regions, intramuscular maintenance regimens were more commonly used in the African region (45.7%) than in the Latin American (3.0%) and Asian (22.9%) regions, whereas intravenous maintenance regimens were more often used in the Latin American (94.0%) and Asian (60.0%) regions than in the African region (21.7%). Similar patterns were found for the treatment of eclampsia across regions.

Conclusions The reported clinical use of $MgSO_4$ for eclampsia prevention and treatment varied widely, and was largely inconsistent with current international recommendations.

Keywords dosing regimen, eclampsia, low- and middle-income settings, magneisum sulphate, pre-eclampsia.

Tweetable abstract $MgSO_4$ regimens for eclampsia prevention and treatment in many hospitals are inconsistent with international recommendations.

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Introduction

Pre-eclampsia/eclampsia is a multisystem disorder of pregnancy that carries a high risk of maternal and perinatal mortality and morbidity worldwide.[1,2] It is estimated that approximately 50 000 women die of pre-eclampsia/eclampsia each year, accounting for over one-tenth of maternal deaths in Asia and Africa, and around one-quarter of maternal deaths in Latin America.[3–5]

Magnesium sulphate ($MgSO_4$) is one of the critical interventions required for reducing severe adverse outcomes from pre-eclampsia/eclampsia. It is the drug of choice for

both prevention and treatment of eclampsia; halving the risk of eclampsia in women with pre-eclampsia and is superior to either diazepam or phenytoin.[6,7] Currently, the World Health Organization (WHO) and other international organisations recommend two $MgSO_4$ regimens for eclampsia prophylaxis, namely the Pritchard regimen, which is predominantly administered intramuscularly, and the Zuspan regimen, which is administered intravenously.[6,8,9] Despite global efforts, translating this knowledge into clinical practice has been challenging in many countries, particularly those with the highest burden of adverse outcomes associated with pre-eclampsia/eclampsia.

Several barriers to access to and use of $MgSO_4$ have been identified at multiple levels of health systems. These include $MgSO_4$ not being registered or licensed for use for pre-eclampsia/eclampsia, lack of centralised purchasing and distribution mechanisms, lack of evidence-based clinical protocols, insufficient training and shortage of staff to safely deliver $MgSO_4$ and fear of toxicity.[10–15] Nonetheless, there is evidence to suggest that limited coverage of $MgSO_4$ may be related more to local clinical practices than the availability of the medication. For instance, the WHO Multi-Country Survey on Maternal and Newborn Health (WHO MCS) in 2010/11 reported high coverage of $MgSO_4$ use for eclampsia prevention and treatment in facilities in many low- and middle-income countries; however, it did not appear to be related to lower rates of adverse outcomes due to pre-eclampsia/eclampsia.[16]

The main objectives of this study were to characterise the current clinical practices regarding $MgSO_4$ administration for the treatment of pre-eclampsia and eclampsia by obstetric providers within the WHO MCS network; to determine what $MgSO_4$ regimens are recommended for use in these facilities and to what extent these regimens are consistent with current international recommendations. Characterisation of clinical practices related to $MgSO_4$ use will help to inform international efforts to bridge the current evidence-to-practice gap. The study is part of the converging research activities by WHO towards identifying a clinically non-inferior but simpler $MgSO_4$ regimen for eclampsia prevention and treatment.

Methods

This was a cross-sectional survey conducted in the network of health facilities in the WHO MCS. Methodological details of the WHO MCS have been published elsewhere.[17,18] In brief, a stratified, multi-stage cluster sampling approach was used to obtain a global sample of countries from Africa, Asia, Latin America and the Middle East. Within each country, the capital city and two other provinces/states (using probability proportional to the population size sampling method) were selected. In the selected areas, seven health facilities with more than 1000 births per year were randomly selected. If fewer than seven facilities were available, all health facilities in that area were included. In total, this network includes 370 health facilities in 29 countries.

For the present study, we invited all country coordinators of the WHO MCS research network to participate. Co-ordinators of 15 countries (Afghanistan, Argentina, Brazil, Democratic Republic of the Congo, India, Japan, Kenya, Mexico, Niger, Nigeria, Pakistan, Paraguay, Peru, Sri Lanka, Uganda) representing a total of 233 health facilities agreed to participate in the study (see Figure S1). Country coordinators identified and approached heads of obstetric departments or maternity units of facilities that had previously participated in the WHO MCS. They were invited (via telephone or email) to participate in an anonymous questionnaire survey on institutional clinical practices relating to $MgSO_4$ use for the treatment of pre-eclampsia and eclampsia. Email addresses were then provided by country co-ordinators to the study investigators.

An online survey (see Appendix S1) was created and sent directly to the identified participants by email by the investigators at WHO in October 2015. No identifying information of individual participants or health facilities was collected. The survey lasted 8 weeks and reminders were sent to all invited participants at 2-, 4- and 6-week timepoints. In Uganda, a self-administered paper survey was used in some facilities where email addresses of target participants were not available. In total, 215 of the 233 health facilities that were invited to participate in either an online or a paper-based survey could be reached: 200 out of 218 emails were successfully delivered and 15 printed questionnaires were distributed.

The survey included facility characteristics, $MgSO_4$ availability and potential barriers to its access, availability and distribution of clinical protocols for $MgSO_4$ use, $MgSO_4$ dosing regimens for the treatment of pre-eclampsia and eclampsia, institutional capacity to manage $MgSO_4$ toxicity, and preferences for different options of simplified $MgSO_4$ regimens. The survey questionnaire was pre-tested in six health facilities outside the study network and revised accordingly. The questionnaire was translated into Spanish, French and Japanese for use in countries where English is not an official language.

Data analyses were mainly descriptive. Cross-tabulation was used to describe health facility characteristics, availability and use of $MgSO_4$ by geographical regions. The reported $MgSO_4$ regimens were grouped by the predominant route of administration. Intravenous maintenance regimens and intramuscular maintenance regimens were sub-categorised into 'higher' or 'lower' dose regimens based on comparison of their total dose to the total 24-hour dose of the Zuspan (28 g) or Pritchard regimen (44 g), respectively.

The WHO Human Reproductive Programme Research Project Review Panel reviewed and approved the scientific content of the study. The WHO Research Ethics Review Committee reviewed and approved the study (protocol ID: A65900). Participation was voluntary and an informed consent form was included in the introductory part of the questionnaire. Participants were able to respond to the survey questions only after granting their consent.

Results

A total of 147 out of 215 (68%) participants who received the survey provided responses. The response rates were similar across regions. Table 1 presents the characteristics of health facilities. There were comparatively more respondents from the African region than other regions. Overall, most health facilities were publicly funded facilities, located in urban areas and not exclusively for maternity service provision; half of them were tertiary-care facilities. The characteristics of the facilities were relatively similar in the African and Asian regions with regard to the level of facilities and whether exclusively for maternity service provision; in the Latin American region, the vast majority of facilities were located in urban areas, most facilities were tertiary hospitals and around one-third were exclusively maternity facilities.

Table 1. Characteristics of health facilities by regions, *n* (%)

Total number of health facilities	Africa *n* = 61	Latin America *n* = 40	Asia *n* = 46	Total *n* = 147
Type of facility				
Public	48 (78.7)	32 (80.0)	33 (71.7)	113 (76.9)
Private	13 (21.3)	8 (20.0)	11 (23.9)	32 (21.8)
Other	0	0	2 (4.4)	2 (1.3)
Location of facility*				
Rural	12 (20.0)	0	4 (8.7)	16 (11.0)
Peri-urban	12 (20.0)	2 (5.0)	8 (17.4)	22 (15.0)
Urban	36 (60.0)	38 (95.0)	34 (73.9)	108 (74.0)
Level of facility**				
Primary	9 (14.8)	1 (2.6)	7 (15.2)	17 (11.6)
Secondary	27 (44.3)	8 (20.5)	12 (26.1)	47 (32.2)
Tertiary	25 (40.9)	30 (76.9)	27 (58.7)	82 (56.2)
Exclusive maternity facility***				
Yes	9 (14.8)	12 (30.0)	6 (13.3)	27 (18.5)
No	52 (85.2)	28 (70.0)	39 (86.7)	119 (81.5)

*Missing data for one health facility in the African region.
**Missing data for one health facility in the Latin American region.
***Missing data for one health facility in the Asian region.

Availability of $MgSO_4$ and formal protocol for treatment of pre-eclampsia and eclampsia

As shown in Table 2, $MgSO_4$ was reported to be always available in 87.4% of all health facilities. This was highest in the Latin American region and lowest in the African region. Among health facilities where $MgSO_4$ was reported not to be always available (n = 16), the most common barriers were inadequate supplies (stock-out) (11/16) and high financial cost of $MgSO_4$ to the facility (10/16) and to women and their families (8/16).

Most respondents reported that their health facilities had a formal protocol for the treatment of pre-eclampsia and eclampsia, and this was most common in the Latin American region, followed by the African and Asian regions (Table 2). In the three regions, the most common approach used to distribute the protocol was through visible posters in obstetric and labour wards. The protocol was also often communicated through staff training in half of the facilities reporting availability of protocols. About one-third of these facilities provided their protocols to healthcare providers as printed materials.

Treatment of pre-eclampsia and eclampsia with $MgSO_4$

Respondents reported that 24.3% of all facilities used $MgSO_4$ for treatment of mild pre-eclampsia (35.1% in Latin America, 22.7% in Asia and 18.6% in Africa). Over 90% of health facilities in all three regions used $MgSO_4$ for treatment of severe pre-eclampsia and eclampsia (Table S1). With respect to the diagnosis and management of $MgSO_4$ toxicity, 27.8% of all facilities reported having the capacity to routinely measure serum magnesium concentration. This was most common in the Latin American region (48.6%), followed by the Asian region (37.5%) and was uncommon in the African region (7.3%). Calcium gluconate was reported to be always available in 71.0% of all facilities. Availability was higher in the Latin American (94.3%) and Asian (87.5%) regions compared with the African region (44.6%).

Table 3 presents the dosing regimens of $MgSO_4$ used for the treatment of severe pre-eclampsia by geographical regions. In more than half of all facilities, $MgSO_4$ was administered as a loading dose followed by continuous intravenous maintenance dose, and in one-quarter of facilities the loading dose was followed by intramuscular maintenance dose. In a few facilities, the maintenance dose was reported to be administered either intravenously or intramuscularly (7.0%) or both intravenously and intramuscularly (3.5%). A loading dose alone and maintenance dose alone were reported to be used in 6.1% and 2.6% of facilities, respectively. Overall, about one-quarter of all facilities used dosing regimens that were consistent with the Zuspan regimen and only 7.0% used regimens that were consistent with the Pritchard regimen.

Table 2. Availability of $MgSO_4$ and a formal (written) protocol for the treatment of pre-eclampsia and eclampsia by regions, *n* (%)

Total number of health facilities	Africa *n* = 61	Latin America *n* = 40	Asia *n* = 46	Total *n* = 147
$MgSO_4$ always available*				
Yes	48 (78.7)	36 (94.7)	41 (93.2)	125 (87.4)
No	13 (21.3)	2 (5.3)	3 (6.8)	18 (12.6)
Formal protocol available**				
Yes	51 (83.6)	35 (97.2)	35 (81.4)	121 (86.4)
No	10 (16.4)	1 (2.8)	8 (18.6)	19 (13.6)
Distribution of the protocol***	(*n* = 51)	(*n* = 35)	(*n* = 35)	(*n* = 121)
Printed and circulated to staff	13 (25.5)	16 (47.1)	10 (28.6)	39 (32.5)
Communicated in staff training	22 (43.1)	21 (61.8)	16 (45.7)	59 (49.2)
Posted visibly in obstetrics and labour wards	41 (80.4)	21 (61.8)	19 (54.3)	81 (67.5)
Available online at the hospital website	1 (2.0)	10 (29.4)	0	11 (9.2)
Others	1 (1.9)	0	0	1 (0.8)

*Missing data for two health facilities in the Latin American region and two in the Asian region.
**Missing data for four health facilities in the Latin American region and three in the Asian region.
***In health facilities having a clinical protocol for pre-eclampsia and eclampsia treatment, the method of protocol distribution was asked using a multiple choice question. Missing data for one health facility in the Latin American region.

Table 3. Magnesium sulphate regimens used for treatment of severe pre-eclampsia by regions, *n* (%)

Total number of health facilities*	Africa *n* = 52	Latin America *n* = 36	Asia *n* = 42	Total *n* = 130
Loading dose alone	6 (13.0)	0	1 (2.9)	7 (6.1)
Loading dose + IV maintenance	10 (21.7)	31 (94.0)	21 (60.0)	62 (54.4)
Zuspan regimen	4 (8.7)	10 (30.3)	16 (45.7)	30 (26.4)
Lower dose regimen (with respect to Zuspan regimen)**	2 (4.3)	3 (9.2)	2 (5.7)	7 (6.1)
Higher dose regimen (with respect to Zuspan regimen)***	4 (8.7)	18 (54.5)	3 (8.6)	25 (21.9)
Loading dose + IM maintenance	21 (45.7)	1 (3.0)	8 (22.9)	30 (26.3)
Pritchard regimen	6 (13.1)	1 (3.0)	1 (2.9)	8 (7.0)
Lower dose regimen (with respect to Pritchard regimen)****	15 (32.6)	0	7 (20.0)	22 (19.3)
Higher dose regimen (with respect to Pritchard regimen)*****	0	0	0	0
Loading dose + IV or IM maintenance	6 (13.0)	1 (3.0)	1 (2.9)	8 (7.0)
Loading dose + IV and IM maintenance	2 (4.4)	0	2 (5.7)	4 (3.5)
Maintenance dose alone	1 (2.2)	0	2 (5.7)	3 (2.6)

IM, intramuscular injection; IV, intravenous infusion.
*Missing data for six health facilities in the African region, three facilities in the Latin American region and seven facilities in the Asian region.
**Total dose <28 g given between 1 and 10 hours.
***Total dose >28 g given between 8 and 48 hours.
****Total dose <44 g given between 1 and 24 hours.
*****Total dose >44 g in 24 hours.

Across regions, intravenous $MgSO_4$ maintenance regimens were used most commonly in the Latin American region (94.0%), followed by the Asian region (60.0%) and less commonly in the African region (21.7%). Of these, 45.7% of health facilities in the Asian region used dosing regimens that were consistent with the Zuspan regimen, whereas 54.5% of health facilities in the Latin American region used higher dosing regimens (compared with the Zuspan regimen). Intramuscular $MgSO_4$ maintenance regimens were most commonly used in the African region (45.7%), followed by Asian region (22.9%) and was used rarely in the Latin American region (3.0%). Of these, 32.6% of health facilities in the African region and 20.0% of facilities in the Asian region used lower dosing regimens (compared with the Pritchard regimen) (Table 3).

Similar patterns were found for the treatment of eclampsia across regions (Table 4). Likewise, only 23.1% of all health facilities used dosing regimens that were consistent

Table 4. Magnesium sulphate regimens used for treatment of eclampsia by regions, *n* (%)

Total number of health facilities*	Africa *n* = 55	Latin America *n* = 36	Asia *n* = 42	Total *n* = 133
Loading dose only	3 (6.1)	0	0	3 (2.6)
Loading dose + IV maintenance	13 (26.5)	31 (91.2)	24 (70.6)	68 (58.1)
Zuspan regimen	5 (10.2)	6 (17.7)	16 (47.1)	27 (23.1)
Lower dose regimen (with respect to Zuspan regimen)**	3 (6.1)	4 (11.7)	2 (5.9)	9 (7.7)
Higher dose regimen (with respect to Zuspan regimen)***	5 (10.2)	21 (61.8)	6 (17.6)	32 (27.3)
Loading dose + IM maintenance	22 (45.0)	2 (5.9)	4 (11.8)	28 (23.9)
Pritchard regimen	9 (18.4)	2 (5.9)	0	11 (9.4)
Lower dose regimen (with respect to Pritchard regimen)****	13 (26.6)	0	4 (11.8)	17 (14.5)
Higher dose regimen (with respect to Pritchard regimen)*****	0	0	0	0
Loading dose + IV or IM maintenance	8 (16.4)	1 (2.9)	1 (2.9)	10 (8.5)
Loading dose + IV and IM maintenance	2 (4.0)	0	5 (14.7)	7 (6.0)
Maintenance dose only	1 (2.0)	0	0	1 (0.9)

IM, intramuscular injection; IV: intravenous infusion.
*Missing data for six health facilities in the African region, two facilities in the Latin American region and eight facilities in the Asian region.
**Total dose <28 g given between 1 and 24 hours.
***Total dose >28 g given between 8 and 48 hours.
****Total dose <44 g given between 1 and 24 hours.
*****Total dose >44 g in 24 hours.

with the Zuspan regimen and 9.4% used regimens that were consistent with the Pritchard regimen. Across regions, 10.2% of health facilities in the African region, 17.7% in the Latin American region and 47.1% in the Asian region used dosing regimens that were consistent with the Zuspan regimen; and 18.4% of health facilities in the African region and 5.9% in the Latin American region used dosing regimens that were consistent with the Pritchard regimen (Table 4).

In this survey, preferences for a simplified regimen in terms of administration route and dosage quantities were investigated. Around two-thirds of all respondents answered to this question. About half of respondents (49/105) felt that an exclusively intravenous regimen was more likely to increase the coverage of $MgSO_4$ as an intervention for eclampsia prevention and treatment. This preference was most common in the Latin American region (70.0%, 21/30), followed by the Asian (44.1%, 15/34) and African regions (31.7%, 13/41). In addition, 42.5% of respondents reported that a single, one-off dose of $MgSO_4$ through an intravenous route was more likely to increase coverage. This preference was most common in the African region (50.0%, 22/44) and less common in the Latin American (34.6%, 9/26) and Asian regions (38.9%, 14/36).

Discussion

Main findings

In our study, respondents reported that $MgSO_4$ was regularly available in the majority of health facilities surveyed, although it was less commonly available in the African compared to other regions. In spite of the availability of a clinical protocol for treatment of pre-eclampsia and eclampsia in most facilities, the $MgSO_4$ dosing regimens in use varied widely and were largely inconsistent with current international recommendations. Overall, around one-fifth of the surveyed health facilities in the African region, one-third of those in the Latin American region and half of those in the Asian region used $MgSO_4$ regimens for treatment of pre-eclampsia in keeping with current recommendations. This pattern is similar for treatment of eclampsia across the three regions.

Strengths and limitations

This survey was conducted in the existing network of health facilities within the WHO MCS across three continents with a focus on resource-constrained settings. It covered a wide geographical scope and provided an opportunity for participants whose first language was not English to participate. For a predominantly online survey, the response rate was considered reasonable and representative of the target sample. However, there are few limitations to be considered. First, inclusion of the capital city as one of the three otherwise randomly selected geographical areas from each country in the WHO MCS network may bias the results. Moreover, the sampling was restricted to health facilities with at least 1000 deliveries per annum and able to provide caesarean section, which were mainly secondary and tertiary-care facilities. These facilities are likely to be better resourced and might not be representative of

smaller facilities although smaller facilities traditionally do not provide care for women with pre-eclampsia. Therefore, an uneven distribution of participating health facilities across the three regions could bias the interpretation of observed differences in clinical practice. Another limitation is that heads of obstetric departments or maternity units were requested to provide a consensus view of institutional clinical practices related to $MgSO_4$ and it is uncertain to what extent these views captured variations that sometimes exist among individual providers in health facilities. Lastly, the survey assessed the reported use of $MgSO_4$ regimens rather than its actual (or observed) use. Nevertheless, the significant variation in the regimens used suggests that reporting bias towards internationally recommended regimens is unlikely.

Interpretation

Magnesium sulphate has been recommended internationally as the first-line drug for treatment of severe pre-eclampsia and eclampsia.[6–9] This recommendation has been introduced into national policies in many countries as an essential intervention for reduction of maternal mortality,[10] which has to a large extent improved the availability of the drug. In our study, $MgSO_4$ was regularly available in the vast majority of health facilities, albeit being lower in the facilities in the African region. Barriers to accessing $MgSO_4$ at facility level included inadequate supplies and perceived high costs to both health facility (e.g. costs of equipment and materials to administer and monitor $MgSO_4$) and users, which are consistent with findings in other studies.[12,14,15]

Despite the fact that coverage of $MgSO_4$ for the prevention and treatment of eclampsia has improved, it has not necessarily translated into recommended clinical practice at different health facility levels. We found that about one-quarter of all facilities were using $MgSO_4$ for treatment of mild pre-eclampsia, despite a lack of recommendation on such practice. This may be related to the evidence from a systematic review, which indicates that women with non-severe pre-eclampsia can also benefit from $MgSO_4$ in terms of reduction of eclampsia risk.[7] However, the number needed to treat of 100 with confidence intervals ranging from 100 to 500 raises questions about cost-effectiveness and unnecessary adverse effects when used in this larger proportion of women with pre-eclampsia.[7,19,20] With respect to the treatment of severe pre-eclampsia and eclampsia, we found a wide variation in the use of $MgSO_4$ regimens in terms of administration route and dosage quantities, most of which were not in line with international recommendations. This may reflect inadequate introduction of current international recommendations into local protocols, or may be partly attributed to the complexity of administration of the regimens. Studies in India, Pakistan and Mexico reported that confusion of intravenous and intramuscular regimens as well as challenges in calculating and preparing the dosage were major constraints to administering $MgSO_4$ appropriately.[11,14,21]

In our study, intramuscular regimens were more often used in the African region than in the Asian and Latin American regions, probably reflecting regional differences in the availability of supplies and expertise that are required for administration of the intravenous regimens. Compared with the total dosage of the Pritchard regimen, most of these health facilities administered lower dose regimens, probably due to fear of the toxicity of $MgSO_4$ and insufficient ability to manage severe adverse effects that could potentially result from $MgSO_4$. On the other hand, health facilities in the Asian and Latin American regions were more likely to use intravenous regimens. In the Latin American region, higher dose regimens (compared with the Zuspan regimen) were often used, particularly for the treatment of eclampsia. This may reflect healthcare providers' familiarity with intravenous administration of $MgSO_4$ and a belief that higher dosage may result in greater clinical efficacy, as previously suggested in some old studies.[22,23] In the absence of standard dose–exposure studies on minimum effective concentration of $MgSO_4$,[24,25] this variation in clinical practice is likely to persist for some time due to conflicting views on the optimal dosing regimen to prevent eclamptic seizures. The systematic review of small-scale randomised trials and observational studies on several alternative $MgSO_4$ regimens in recent years have concluded that there is still insufficient evidence on their benefits to justify their introduction into clinical practice.[26,27]

Conclusion

The clinical practice patterns on the use of $MgSO_4$ for eclampsia prevention and treatment varied widely, and were largely inconsistent with the current recommendations. To achieve the desirable maternal and newborn outcomes related to pre-eclampsia and eclampsia, evidence-based practices need to be properly implemented at the facility level. In order to bridge the identified recommendation-to-practice gap, future studies should focus on understanding the underlying reasons for non-adherence to international recommendations to complement the knowledge gained from our study.

Considering the barriers to access and use of currently recommended $MgSO_4$ regimens, a simplified regimen needs to be further explored through a non-inferiority multi-country trial to derive a clinically efficacious regimen that is applicable at all levels of health system and in a wide variety of socio-economic settings. Such a simplified regimen could potentially minimise the challenges of shortages

of supplies and skilled staff that currently impede a wider implementation of recommended clinical practices.

Disclosure of interests

None declared. Completed disclosure of interests form available to view online as supporting Information.

Contribution to authorship

OTO and AMG conceived the study. SL and JPV prepared the study protocol with input from OTO. QL was in charge of overall project coordination and data management. PL, GC and ZQ coordinated data collection in the regions. QL and OTO conducted data analysis. QL prepared the first draft of the manuscript. All authors contributed to interpretation of the results and revised the manuscript for intellectual content. All authors approved the manuscript for publication. This article represents the views of the named authors only, and not the views of their institutions or organisations.

Details of ethics approval

The WHO Research Ethics Review Committee reviewed and approved the study on 4 August 2015 (protocol ID: A65900, version 2).

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Figure S1. Countries participating in the Survey.

Table S1. Treatment of pre-eclampsia and eclampsia with magnesium sulphate by regions.

Appendix S1. A survey of global clinical practice patterns in the use of magnesium sulphate for the treatment of pre-eclampsia and eclampsia. ■

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