

Emergency Obstetric Care: Strategy for Reducing Maternal Mortality in Developing Countries

Bhandari TR,¹ Dangal G²

¹Achutha Menon Centre for Health Science Studies, Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum, Kerala, India, ²Department of Obstetrics and Gynaecology, Kathmandu Model Hospital, Kathmandu, Nepal

Twenty-five years have passed since the global community agreed in Nairobi to address the high maternal mortality by implementing the Safe Motherhood Initiative. However, every year nearly three million women die due to pregnancy related causes. This tragedy is avoidable if women have timely access to required emergency obstetric care.

Emergency obstetric care refers to life-saving services for maternal and neonatal complications provided by skilled health workers. Since the beginning of the 1980's, several efforts have been intensified to improve maternal and child health status and reducing the high morbidity and mortality. There was built on a worldwide consensus to provide improved maternal and child health care for addressing the high morbidity and mortality. All participant countries agreed to integrate emergency obstetric care services in their national health care system.

Emergency obstetric care is one of the strategies for reducing the maternal mortality as pregnancy related complications are unpredictable. However, many women in developing countries do not have access to essential health care services including emergency obstetric care. Basic emergency obstetric care by skilled birth attendants or timely referral for further comprehensive emergency obstetric care can reduce maternal deaths and disabilities significantly. This paper is based on the results published in PubMed, Medline, Lancet, WHO and Google Scholar web pages from 1990 to 2013.

Keywords: developing countries, emergency obstetric care, maternal mortality, Nepal.

INTRODUCTION

Achieving Millennium Development Goal (MDG) 5 still remains a challenge to the developing countries although maternal mortality reduction is a priority agenda of each country.¹ Most efforts for improving the health status of the women and reduce higher morbidity and mortality have been intensified since the beginning of the 1980's. A worldwide consensus was built to reduce the high morbidity and mortality by improving maternal and child health care services. Most of the countries agreed to integrate emergency obstetric care services in their national health care system.^{2,3}

In most of developing countries, the major causes of maternal morbidity and mortality are hypertensive diseases with eclampsia, postpartum hemorrhage,

infections, obstructed labor, ruptured uterus and unsafe abortion. Maternal mortality and stillbirth are highly correlated with the access of emergency obstetric care services.⁴⁻⁶ Essential obstetric care (EOC) and emergency obstetric care (EmOC) have been proposed as strategies to address the high maternal mortality and morbidity since the beginning of the 1990's.

Fundamentally, EOC and EmOC are different approaches of obstetric care. EOC focuses on all pregnant women and is based on the idea that obstetric complications can be predicted and prevented by employing the concept of "high risk" and on the other hand EmOC focuses on the identification, referral and treatment of women with obstetric complications and regards equal risk to all pregnant women.^{7,8} This paper mainly focuses to assess the emergency obstetric care services as a successful strategy for reducing the maternal mortality.

CORRESPONDENCE

Mr Tulsi Ram Bhandari
Achutha Menon Centre for Health Science Studies, Sree
Chitra Tirunal Institute for Medical Sciences and Technology
Trivandrum, Kerala, India.
Email: tulsib2004@gmail.com
Phone: +977- 9751009863

METHODS

We did a literature review for assessing the 'obstetric care and maternal morbidity and mortality' publications. The literature search focused mainly on the findings of the studies that were published in national and international levels. The method adopted for review was literature search from PubMed, Medline, Lancet, WHO and Google Scholar web pages published from 1990 to 2013. Different search terms like obstetric care, maternal morbidity and mortality, essential obstetric care (EOC) and emergency obstetric care (EmOC) and pregnancy complication were used to locate relevant references and the location of the relevant journal articles. This was augmented by unpublished literature and relevant experience sharing obtained by contacting experts in the field. We also looked at other relevant publications like reports, training manuals and books. All the related references were cited and organized by using referencing software Zotero Standalone.

Emergency obstetric care

Emergency obstetric care is necessary to save lives of pregnant women and neonates. It is divided into basic emergency obstetric care and comprehensive emergency obstetric care. Basic emergency obstetric care refers to lifesaving services for maternal complication being provided by a health facility or professional. It includes administration of parenteral antibiotics, oxytocin and anticonvulsants drugs for pre-eclampsia and eclampsia, manual removal of placenta and retained products and assisted vaginal delivery. Similarly, comprehensive emergency obstetric care covers all above basic care plus two other services i.e. performance of caesarean section and blood transfusion.^{2,7,9-11} By emergency obstetric care all women must be ensured of basic as well as comprehensive emergency obstetric care services for all kinds of complications during pregnancy, childbirth and early postpartum period and their neonates.

Need and importance of emergency obstetric care

The emergency obstetric care is one of the strategies to reduce maternal and neonatal mortality by employing specific interventions during pregnancy, delivery and postnatal period. In developing countries, many women die from ectopic pregnancy, severe

haemorrhage, prolonged-obstructed labor, ruptured uterus, retained placenta, infections, eclampsia and pre-eclampsia and so on. For preventing and managing the above-mentioned complications emergency obstetric care is inevitable. All pregnant women are at risk of obstetric complications and it is unpredictable in most of the instances. All pregnant women and neonates should be considered at risk and with a good back-up of required emergency obstetric care services should be available. Emergency obstetric care services help to manage new-born distresses by performing required surgery and resuscitation timely.¹⁻¹⁰

Emergency obstetric care: global situation

Out of the total maternal deaths nearly 10% women die from prolonged obstructed labour annually in the world. Most of the life-threatening complications occur during labor, delivery and early postnatal period and these cannot be predicted by antenatal screening.^{3,12,13}

In low-income countries, maternal health care programs should focus on emergency obstetric care. Reduction in maternal mortality will not be possible without the adequate management of obstetric complications. Every pregnant woman should have access to health facilities that provide emergency obstetric care. Neither effective prenatal care nor identifying risk will help to reduce the maternal mortality if emergency obstetric care is unavailable or inaccessible or not utilized.^{3,14}

Two and a half decades have passed since the global community agreed in Nairobi to reduce maternal deaths by implementing the Safe Motherhood Initiative in to their national health care system. However, every year nearly three million pregnant women are dying. There is no ambiguity this is an avoidable tragedy if women have access to quality emergency obstetric care.¹⁵ Evidence indicates that access to skilled birth attendants at delivery and timely referral service to emergency obstetric care services can reduce maternal mortality and morbidity radically.¹⁶ The United Nations estimates 15% of pregnant women develop obstetric complications that require emergency obstetric care. Therefore, out of the total deliveries at least 15% women should attend health facilities for emergency obstetric care services.^{2,17,18} A study revealed that obstetric

complications are common in United States in spite of intensive prenatal care and screening. It further explained that one in every thirteen women categorized as “low-risk” and receiving intensive prenatal care developed serious emergency obstetric complications.¹⁹

The high cost of emergency obstetric care is considered as catastrophic health expenditure for households. In most of the low resource countries, three delays i.e. deciding to seek appropriate medical help for an obstetric emergency, reaching an appropriate obstetric facility and receiving adequate care when a facility is reached exist in seeking and providing the emergency care services. For addressing the low utilization of emergency obstetric care services in rural and slum areas there should be increased availability, accessibility, and quality of emergency obstetric services to the rural areas and slums of low income countries.^{15,16,20,}

Availability and accessibility of emergency obstetric care

Various factors are responsible for utilization of emergency obstetric care such as late decision-making at households, inadequate transport facilities, insecurity at night, high cost of health services, unfriendly service providers, poorly equipped health facilities, time, location and geographical conditions.^{21,22}

Theoretical concept of quality of care is difficult to translate into a concrete practical approach. The quality of the services is high in urban areas compared to rural areas. For improving and maintaining the quality, highly motivated staff with team work, collaborative activities with community, improved overall functioning of the health facilities, community awareness and positive perception towards providers are the inevitable aspects of emergency obstetric care.²³⁻²⁵

An inter-countries cross-sectional study on global patterns of utilization of emergency obstetric care revealed that the comprehensive emergency obstetric care facilities are usually available to meet the recommended minimum number for the size of the population. Basic emergency obstetric care facilities are consistently not available in sufficient numbers both in countries with high and moderate levels of

maternal mortality. The majority of health facilities provide very limited interventions of maternal and emergency obstetric care services.²⁶

Shortage of human resources is a major obstacle in providing quality services in emergency obstetric care services in developing countries. Women were often dissatisfied with the care which they receive during childbirth and the technical quality of emergency obstetric care had not been adequately maintained.²⁷ Most of the qualified health workers concentrate in a few urban parts while health workers are insufficient and unequally distributed in the rural areas. It means the availability of qualified human resources does not automatically translate into higher availability of quality emergency obstetric care.²⁸

In last couple of years, emergency obstetric care service utilization rate has been increasing in South East Asian and Sub-Saharan countries²⁹ even though it is not enough to meet the Millennium Development Goal. In countries like Bhutan, Cameroon and Rajasthan, India small proportions of births are being delivered by cesarean section, which indicates that many women are not receiving the required emergency obstetric care. Home delivery is a common practice in these three countries. Despite the availability of emergency obstetric care facilities some women cannot or do not seek required emergency obstetric care services in some parts of these countries due to their socio-cultural beliefs and practices.³⁰ In Zaire, 29 % women had obstructed labor from the high-risk group and two-thirds women from low-risk group had obstructed labor. All of these women were categorized as risk and risk-free group by screening program during antenatal period. It is hard to predict emergency obstetric care from antenatal screening or other antenatal care services and visits.³¹

The emergency obstetric care is critical care to reduce maternal and newborn mortality and morbidity.³² In many settings, agreed minimum coverage and standard of emergency obstetric care is not met yet. In most cases, particular barriers to achieving improved coverage can easily be identified and must be addressed as a matter of urgency⁹ and there is urgent need to innovate the health facilities and develop the capabilities of the of health workers of the national health system in the developing countries, whereas health system is running with limited resources.³³

Critical steps of emergency obstetric care

Emergency obstetric care depends upon various factors. It is a reflection of entire knowledge, attitude and practice of the family community and health facilities towards the delivery care. For addressing the emergency obstetric care, there is a need to start work from households to health facilities. Between households to health facilities, various factors may create delays in seeking emergency obstetric care. Timely decision-making at the household level, reaching to health facilities, right diagnosis and management of problem at health facilities, continuous monitoring and supervision, and discharge with required counseling are the critical steps of emergency obstetric care services which facilitate the pregnant women for delivering healthy baby with healthy condition.³⁴ The critical steps of the emergency obstetric care are shown in the figure 1.

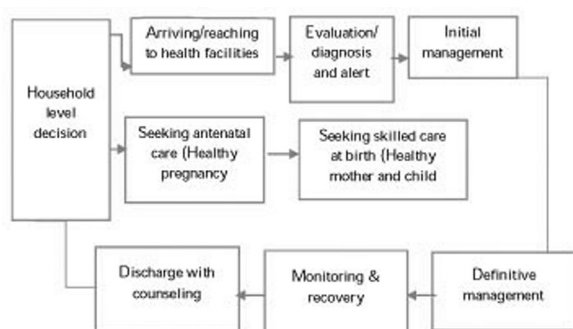


Figure 1. Critical steps of emergency obstetric care services.

Barriers of emergency obstetric care

Barriers of the emergency obstetric care are discussed based on the three delays i.e. delay in deciding to seek care, delay in reaching a first health facilities and delay in receiving care after arriving at health facility.³⁵⁻³⁷ Factors influencing decision-making to seek care under emergency conditions are women's status in the family, perceived severity of the complication, societal expectations, culture and tradition, long distance to health facility, lack of transport, dissatisfaction with providers, user fee and so on. The delay in the decision-making to seek emergency obstetric care contributes to one-third maternal deaths which is distinctly higher in rural areas as compared to urban areas.³⁶⁻⁴⁰

Lack of essential supplies and equipment, difficulty

in obtaining blood for transfusion, lack of adequate operating theater space, shortage of competent and trained staff, lack of supervision and complacency attitudes among staff are common barriers to receiving care after arriving at emergency obstetric care facilities.³⁹⁻⁴¹ The third delay is one of major contributing factors of the high maternal mortality. In most of the developing countries the mean range of this delay is 2.6 to 15.5 hours.⁴²

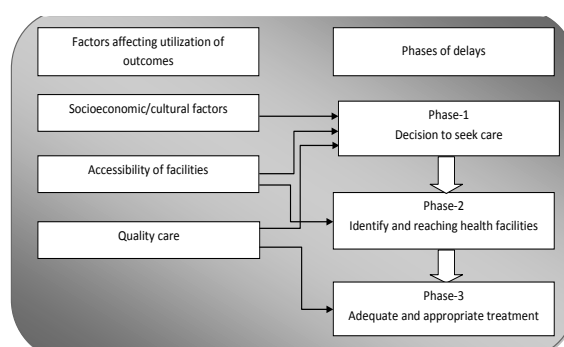


Figure 2. Factors affecting utilization of emergency obstetric care and phases of delays.⁴³

Lessons learned and best practices for improving EmOC

Restructuring, strengthening and upgrading of the existing health system are needed to address the emergency obstetric care in the low-income countries. Health professionals at rural health facilities would not be expected to perform all the emergency obstetric care but would be expected to make a correct diagnosis and refer to women at the comprehensive obstetric care facility in time. For reducing the transportation delays, motorized transportation is likely to be the most acceptable and effective transportation option. The best example of cost effective and time saving motorized transportation of emergency obstetric care is motorcycle ambulance in the rural parts of Malawi, Sierra Leone and some other African countries.⁴⁴⁻⁴⁶

Community awareness and community involvement programs can support in decision-making to seek emergency obstetric care services. Safer birthing practices, information for seeking the care in time and better care of neonates were the cost effective programs to increase the utilization of emergency obstetric care services in Bolivia, Ghana, Nigeria and Sierra Leone. For the community involvement,

they conducted short term training for community motivators, form community blood donor associations and establish community loan funds.⁴ For further strengthening the emergency obstetric care and its referral system, they started work with traditional birth attendants, managed emergency transportation, upgraded referral centers, posted midwives at community level and established maternity homes near to the referral centers.⁴⁷⁻⁵⁰

Improving quality of care at health facilities increases the client's satisfaction as well as utilization rate of the services. Some successful practices for improving the quality of emergency obstetric care are training to the health professionals in lifesaving skills, improving the interpersonal communication and counseling, expanding the roles of non-physician health care providers, ensuring availability of drugs and other supplies and improving the management system of health facilities.⁵¹⁻⁵³

Cost of emergency obstetric care

Still many women in the developing countries do not have precise access to health facilities where lifesaving care services are available.⁵⁴ Obstetric complications and high cost of emergency obstetric care (EmOC) in health facilities increase the catastrophic health expenditure for households which may elevate the delays in seeking and providing care in such countries.^{20,55}

From the provider's prospective, human resource expenses, infrastructure development, medicines and equipment supply, laboratory expenses, cash transfer and subsidies are major costs of emergency obstetric care.⁶ Public providers should identify affordable financing and cost-recovery measures to extend the standard emergency obstetric care services at different settings/levels.

The users' fees have little impact on seeking care at an emergency obstetric care facility in emergency conditions, even though it may contribute for the delays at different levels in care seeking. However, caution is needed, when fees are charged to the low-income countries' women.²⁰ User fees based on income, fee exemptions for certain services, subsidies/cash transfer, additional allowances to the staff/midwives are the best practices to enhance the emergency obstetric care in the low income

countries.⁵⁶

Here is depicted an example of emergency obstetric care cost broken-down based on the different headings of intervention program from Mauritania.²⁰

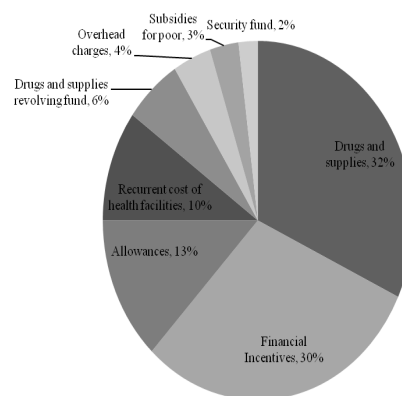


Fig. 3. Distribution of Outlays: EmOC Intervention Program

Indicators of emergency obstetric care

Series of indicators are developed to monitor the progress of emergency obstetric care services. Indicators are used to assess the existing programs, availability of services, utilization pattern particularly by targeted and vulnerable population, availability of life-saving services and quality and standard of services.^{2,9}

The emergency obstetric care should be available to everyone universally. At least four basic emergency obstetric care facilities and one comprehensive emergency obstetric care facility are recommended for every 500,000 population. Emergency obstetric care services should be geographically distributed to the sub-national and peripheral areas. Proportion of births either in basic emergency obstetric care centers or comprehensive obstetric health facilities should be at least 15% of the total births. Regarding the met need, all the women (100%) estimated to have obstetric complications should be treated in emergency obstetric care facilities. The proportion of caesarean section births accounts for neither less than 5% nor more than 15% of the total births in health facilities. Similarly, the case fatality rate among women with obstetric complications in emergency obstetric care facilities should be less than one percent.^{18,30,57,58}

Common emergency obstetric complications

In most developing countries haemorrhage, prolonged/obstructed labour, puerperal sepsis, pre-eclampsia / eclampsia, ruptured uterus, abortion related complications, ectopic pregnancy, and retained placenta are the common emergency obstetric complications.^{2,9,18,30,57,58} The emergency obstetric complication is one of the main causes of maternal deaths in developing countries. Major causes of the maternal mortality and their contribution in mortality are presented in Table 1.

Table 1. Causes of maternal death.³

Causes	Africa	Asia	Latin America and Caribbean	Developed countries
Haemorrhage	33.90%	30.80%	20.80%	13.40%
Hypertensive disorders	9.10%	9.10%	25.70%	16.00%
Sepsis/ Infections	9.70%	11.60%	7.70%	2.10%
Obstructed labour	4.10%	9.40%	13.40%	0.00%
Abortion	3.90%	5.70%	12.00%	8.20%
Ectopic pregnancy	0.50%	0.10%	0.50%	4.90%
Other direct causes	4.90%	1.60%	3.80%	21.30%
Other indirect causes	16.70%	12.50%	3.90%	14.40%
Unclassified deaths	15.40%	19.10%	11.70%	4.80%
Embolism	2.00%	0.40%	0.60%	14.90%

Emergency obstetric care in Nepal

It is estimated that everyday six women died due to pregnancy related complications during pregnancy, delivery and postnatal period in Nepal. Still two-thirds of women deliver at home without assistance of skilled health workers. There is nearly 10% estimated met need of emergency obstetric care currently whereas World Health Organization recommends 100% met need for emergency obstetric care. In Nepal nearly three percent neonates are born by caesarean section while World Health Organization standard of caesarean section births is 5% to 15% of the total births.^{23,30}

In Nepal, more than 85% emergency obstetric care facilities are centered in urban areas whereas 83% of the population lives in rural area. Emergency obstructed case fatality rate of maternal deaths from hospitals reporting is nearly 2% whereas World Health Organization's standard is less than one percent. Out of 75 districts only 31 (41.3%) districts have got emergency obstetric care services in Nepal.^{59,60}

Way forward

In most developing countries existing emergency obstetric care services are not enough to meet the rising demand of the community. Policy makers, planners and other stakeholders including donor agencies should recognize the real need of the community and make basic as well as comprehensive emergency care accessible at all levels of national health care system. The availability and accessibility of emergency obstetric care is most needed for reducing the maternal mortality as per the expectation of MDG 5.

We recommend some ways for further improvement of emergency obstetric care services particularly in the low resource countries. Community people and family members should be made aware about making decisions for seeking care and utilizing the emergency obstetric care facilities early. The utilization rate of emergency obstetric care is lower among the poor and rural women. For reducing the first and second delays, there should be either charitable or loan funds at community level.

For strengthening the referral system, community level traditional birth attendants, female community health volunteers and primary health care level health professionals should be trained to diagnose the emergency complications and refer to the emergency obstetric care facilities on time. There should be a provision of emergency transportation in the community level and maternity waiting houses near to the emergency obstetric care facilities with collaboration of community, local clubs, political parties and other community based organizations.

Health assistants, auxiliary health workers, staff nurses and auxiliary nurse midwives should be trained to handle the emergency obstetric care in the absence of the physician at all basic and comprehensive emergency obstetric care health facilities. In rural

and remote areas of low-income countries, retention of human resources is a major problem. Conducive working environment should be created by providing physical and financial support, career development opportunities such as on-the-job training and further study, and continued supervision and feedback.

At primary health care level, there should be an uninterrupted supply of medicines, equipment and other supplies by establishing revolving funds, improved quality of services by providing basic as well as refresher training to staff and renovated infrastructure and health care delivery management system.

Strong and functional linkages between community and health facilities should be established to address the delays in care seeking and the low utilization rate of emergency obstetric care. Awareness towards services, economic status of family, cost of services, distance to health facilities and transportation are major determinants of the care seeking in the low-income countries. For increasing the utilization rate of emergency obstetric care services, there should be either free emergency obstetric care services in public health facilities or government financing with collaboration of non-profitable organizations and private sector.

In low-income countries, there also is a need for advocacy for research and evidence based emergency obstetric care and dissemination of results to program managers, policy makers, donor agencies and other stakeholders for lobbying and increasing the quality of emergency obstetric care.

CONCLUSIONS

Pregnancy complications can be unpredictable and many women in developing countries do not have access to health facilities whereas lifesaving care is available. Emergency obstetric care is one of the strategies to reduce maternal mortality. It refers to lifesaving services for maternal health complications being provided by a skilled health worker either in health facilities or home. High utilization of emergency obstetric care services can reduce maternal deaths and disabilities drastically in most of the developing countries. It is urgent to extend access and utilization of emergency obstetric care at rural and remote areas of developing countries to reduce

high maternal mortality and meet the millennium targets by the year 2015.

ACKNOWLEDGEMENTS

We are grateful to authors of the reviewed literature whose efforts made this article possible. We acknowledge Dr. V. Raman Kutty and Dr. TK Sundari Ravindran, Achutha Menon Centre for Health Science Studies, Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum, India for the input in the conception of this paper.

DISCLOSURE

The authors report no conflicts of interest in this work.

No violation of human rights and safety.

Funding: Nil

REFERENCES

1. Bhandari TR, Dangal G. Maternal Mortality: Paradigm Shift in Nepal. *N J Obstet Gynaecol*. 2012;7(14):3–8.
2. WHO. Monitoring emergency obstetric care. [Cited 2013 Sep 24]. Available from: <http://www.who.int/reproductivehealth/publications/monitoring/9789241547734/en/index.html>
3. Khan KS, Wojdyla D, Say L, Gulmezoglu AM, Van Look PF. WHO analysis of causes of maternal death: a systematic review. *Lancet*. 2006;367(9516):1066–74.
4. Kwast BE. Building a community-based maternity program. *BJOG*. 1995;48, Suppl(0):S67–S82.
5. McClure EM, Goldenberg RL, Bann CM. Maternal mortality, stillbirth and measures of obstetric care in developing and developed countries. *BJOG*. 2007;96(2):139–46.
6. Post M. Preventing maternal mortality through emergency obstetric care. SARA Project. 1997.
7. Measham DM. Issues in essential obstetric care. Report of a technical meeting of the Inter-Agency Group for safe motherhood. 1995. [Cited 2013 Sep 30]. Available from: <http://www.populationcouncil.com/pdfs/ebert/eocreprt.pdf>
8. Adeyi O, Morrow R. Concepts and methods for assessing the quality of essential obstetric care. *Int J Health Plann Manage*. 1996;11(2):119–34.
9. Kongnyuy E, Hofman J, Broek N. Ensuring effective essential obstetric care in resource poor settings. *BJOG*. 2009;116:41–7.
10. AMDD: Working Group on Indicators. Program note: using UN process indicators to assess needs in emergency obstetric services: Bhutan, Cameroon and Rajasthan, India. *BJOG*. 2002;77(3):277–84.
11. WHO. Essential obstetric care. [Cited 2013 Oct 4]. Available from: <http://www.who.int/mediacentre/factsheets/fs245/en/>

12. Rooks J, Winikoff B, Bruce J. Technical summary: Seminar on Reassessment of the concept of reproductive risk on maternity care and family planning service. New York: The Population Council; 1990.
13. Ranjan A. Universalising availability of emergency obstetric care services. [Cited 2012 Oct 23]. Available from: http://www.shyaminstitute.in/04_04.pdf
14. Nirupam S, Yuster EA. Emergency obstetric care: measuring availability and monitoring progress. *BJOG*. 1995;50, Suppl 2(0):S79–S88.
15. Islam M, Yoshida S. Women are still deprived of access to lifesaving essential and emergency obstetric care. *BJOG*. 2009;106(2):120–4.
16. Essendi H, Mills S, Fotso JC. Barriers to formal emergency obstetric care services' utilization. *J Urban Health*. 2011;88:356–69.
17. UNICEF, UNFPA. Guidelines for monitoring the availability and use of obstetric services. New York: United Nations Children Fund; 1997.
18. Lobis S, Fry D, Paxton A. Program note: applying the UN Process indicators for emergency obstetric care to the United States. *BJOG*. 2005;88(2):203–7.
19. Weatherby N. Antepartum assessment of intrapartum risk: national birth center study. Document présenté lors de la conférence intitulée: a reassessment of the concept of reproductive risk in maternal care and family planning services. New York: Population Council; 1990.
20. Renaudin P, Prual A, Vangeenderhuysen C, Ould Abdelkader M, Ould Mohamed Vall M, Ould El Joud D. Ensuring financial access to emergency obstetric care: three years of experience with obstetric risk insurance in Nouakchott, Mauritania. *BJOG*. 2007;99(2):183–90.
21. Essendi H, Mills S, Fotso JC. Barriers to formal emergency obstetric care services' utilization. *J Urban Health*. 2010;88(S2):356–69.
22. Pearson L, Shoo R. Availability and use of emergency obstetric services: Kenya, Rwanda, Southern Sudan, and Uganda. *BJOG*. 2005;88(2):208–15.
23. Clapham S, Basnet I, Pathak L, McCall M. The evolution of a quality of care approach for improving emergency obstetric care in rural hospitals in Nepal. *BJOG*. 2004;86(1):86–97.
24. Olsen OE, Ndeki S, Norheim OF. Complicated deliveries, critical care and quality in Emergency Obstetric Care in Northern Tanzania. *BJOG*. 2004;87(1):98–108.
25. Chodzaza E, Bultemeier K. Service providers' perception of the quality of emergency obstetric care provided and factors identified which affect the provision of quality care. *Malawi Medical Journal*. 2011;22(4):104–11.
26. Paxton A, Bailey P, Lobis S, Fry D. Global patterns in availability of emergency obstetric care. *BJOG*. 2006;93(3):300–7.
27. Dogba M, Fournier P. Human resources and the quality of emergency obstetric care in developing countries: a systematic review of the literature. *Hum Resour Health*. 2009;7:7. [Cited 2013 Sep 11]. Available from: <http://www.biomedcentral.com/content/pdf/1478-4491-7-7.pdf>
28. Olsen O, Ndeki S, Norheim O. Human resources for emergency obstetric care in northern Tanzania: distribution of quantity or quality? *Hum Resour Health*. 2005;3(1):5.
29. Hossain J, Ross SR. The effect of addressing demand for as well as supply of emergency obstetric care in Dinajpur, Bangladesh. *BJOG*. 2006;92(3):320–8.
30. Bailey PE, Paxton A. Program note: using UN process indicators to assess needs in emergency obstetric services. *BJOG*. 2002;76(3):299–305.
31. The Kasongo Project Team. Antenatal screening for fetopelvic dystocias: a cost-effectiveness approach to the choice of simple indicators for use by auxiliary personnel. *J Trop Med Hyg*. 1984;87(4):173–83.
32. Paxton A, Maine D, Freedman L, Fry D, Lobis S. The evidence for emergency obstetric care. *BJOG*. 2005;88(2):181–93.
33. Bailey P, Paxton A, Lobis S, Fry D. The availability of life-saving obstetric services in developing countries: an in-depth look at the signal functions for emergency obstetric care. *BJOG*. 2006;93(3):285–91.
34. Engender Health (Firm), Joseph L, Mailman School of Public Health. Quality improvement for emergency obstetric care. Leadership manual. New York, NY: Engender Health Mailman School of Public Health, Columbia University; 2003.
35. Binder P, Johnsdotter S, Essén B. Conceptualising the prevention of adverse obstetric outcomes among immigrants using the “three delays” framework in a high-income context. *Soc Sci Med*. [Cited 2013 Sep 11]. Available from: <http://www.sciencedirect.com/science/article/pii/S0277953612006144>
36. Hirose A, Borchert M, Niksear H, Alkozai AS, Cox J, Gardiner J, et al. Difficulties leaving home: a cross-sectional study of delays in seeking emergency obstetric care in Herat, Afghanistan. *Soc Sci Med*. 2011;73(7):1003–13.
37. Chapman RR. Endangering safe motherhood in Mozambique: prenatal care as pregnancy risk. *Soc Sci Med*. 2003;57(2):355–74.
38. Head SK, Yount KM, Sibley LM. Delays in recognition of and care-seeking response to prolonged labor in Bangladesh. *Soc Sci Med*. 2011;72(7):1157–68.
39. Fawcus S, Mbizvo M, Lindmark G, Nystrom L. A Community-based investigation of avoidable factors for maternal mortality in Zimbabwe. *Stud Fam Plann*. 1996;27(6):319.
40. Thaddeus S, Maine D. Too far to walk: maternal mortality in context. *Soc Sci Med*. 1994;38(8):1091–110.
41. Network PMM. Barriers to treatment of obstetric emergencies in rural communities of West Africa. *Stud Fam Plann*. 1992;23(5):279–91.
42. The PMMN. Situation analyses of emergency obstetric care: Examples from eleven operations research projects in West Africa. *Soc Sci Med*. 1995;40(5):657–67.
43. UNFPA. Population issues: safe motherhood- emergency obstetric care. [Cited 2013 Sep 29]. Available from: <http://web.unfpa.org/mothers/obstetric.htm>
44. Bhopal SS, Halpin SJ, Gerein N. Emergency obstetric referral in rural Sierra Leone: what can motorbike ambulances contribute? A mixed-methods study. *Matern Child Health J*. 2012. [Cited 2013 Sep 24]. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/22869500>
45. Hofman JJ, Dzimadzi C, Lungu K, Ratsma EY, Hussein J. Motorcycle ambulances for referral of obstetric emergencies in rural Malawi: do they reduce delay and what do they cost? *BJOG*. 2008;102(2):191–7.

46. Krasovec K. Auxiliary technologies related to transport and communication for obstetric emergencies. *BJOG*. 2004;85,Suppl1(0):S14–S23.
47. Maine D, Akalin MZ, Chakraborty J, De Francisco A, Strong M. Why did maternal mortality decline in Matlab? *Stud Fam Plann*. 1996;27(4):179–87.
48. Poovan P, Kifle F, Kwast BE. A maternity waiting home reduces obstetric catastrophes. *World Health Forum*. 1990;11(4):440–5.
49. Chandramohan D, Cutts F, Millard P. The effect of stay in a maternity waiting home on perinatal mortality in rural Zimbabwe. *J Trop Med Hyg*. 1995;98(4):261–7.
50. Djan JO, Kyei-Faried S, Twum S, Danquah JB, Ofori M, Browne EN. Upgrading obstetric care at the health center level, Juaben, Ghana. The Kumasi PMM Team. *Int J Gynaecol Obstet*. 1997;59 Suppl 2:S83–90.
51. Oyesola R, Shehu D, Ikeh AT, Maru I. Improving emergency obstetric care at a state referral hospital, Kebbi State, Nigeria. The Sokoto PMM Team. *Int J Gynaecol Obstet*. 1997;59 Suppl 2:S75–81.
52. White SM, Thorpe RG, Maine D. Emergency obstetric surgery performed by nurses in Zaïre. *Lancet*. 1987;2(8559):612–3.
53. Mbaruku G, Bergstrom S. Reducing maternal mortality in Kigoma, Tanzania. *Health Policy Plan*. 1995;10(1):71–8.
54. Hussein J, Kanguru L, Astin M, Munjanja S. The effectiveness of emergency obstetric referral interventions in developing country settings: a systematic review. *PLoS Med*. 2012;9(7). [Cited 2013 Sep 11]. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3393680/>
55. Borghi J, Hanson K, Acquah CA, Ekanmian G, Filippi V, Ronsmans C, et al. Costs of near-miss obstetric complications for women and their families in Benin and Ghana. *Health Policy Plan*. 2003;18(4):383–90.
56. The national subsidy for deliveries and emergency obstetric care in Burkina Faso. *Health Policy Plan*. 2011;26(Suppl. 2):ii30–ii40.
57. World Health Organization, United Nations Population Fund, United Nations Children's Fund. Guidelines for monitoring the availability and use of obstetric services. New York: UNICEF, WHO, UNFPA. 1997. [Cited 2013 Sep 11]. Available from: http://www.childinfo.org/files/maternal_mortality_finalgui.pdf
58. Kongnyuy EJ, Leigh B, van den Broek N. Effect of audit and feedback on the availability, utilisation and quality of emergency obstetric care in three districts in Malawi. *Women and Birth*. 2008;21(4):149–55.
59. Rana TG, Chataut BD, Shakya G, Nanda G, Pratt A, Sakai S. Strengthening emergency obstetric care in Nepal: The Women's Right to Life and Health Project (WRLHP). *BJOG*. 2007;98(3):271–7.
60. Rana TG, Rajopadhyaya R, Bajracharya B, Karmacharya M, Osrin D. Comparison of midwifery-led and consultant-led maternity care for low risk deliveries in Nepal. *Health Policy Plan*. 2003;18(3):330–7.