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Maternal health improvement through root cause analysis of severe maternal morbidity (maternal near miss) in Isfahan, Iran

Sepideh Zhali, Shahnaz Kohan¹, Azar Danesh Shahraki², Marjan Beigi¹

Abstract:

INTRODUCTION: Investigating severe maternal morbidity and near-miss cases are applied internationally as a new indicator to examine the quality of maternal care and as an effective strategy to reduce maternal mortality. This study aimed to determine the root causes of severe maternal morbidity in order to improve maternal health.

MATERIALS AND METHODS: The present research is a descriptive case series study. The data was obtained from the hospital and health records of mothers admitted to hospitals affiliated to Isfahan University of Medical Sciences due to severe morbidity in the first 6 months of 2018, which were selected randomly. The data collection was completed by interviews with the mentioned mothers and 14 related health-care staffs and that led to the development of the morbidity story. The compiled story of each case was evaluated by the root analysis team's opinion. Causes of morbidity were determined according to a root cause analysis checklist composing of factors such as health-care services (human and structural factors), family-social status, and disease status of maternal morbidity.

RESULTS: The findings indicated that human factors related to the health system led to severe maternal morbidity more than any cause. Inadequate knowledge and skills of service providers, disregard for guidelines and protocols, lack of teamworking, and lack of considering competency were the most important human factors. Disease condition, family, and social status were the other related factors, respectively.

CONCLUSION: Human factors are the most important cause of maternal morbidity based on the results of this study. Therefore, modifying the health structure can be one of the most important reducing factors for maternal mortality in order to improve the services for these individuals.

Keywords:

Iran, maternal near-miss, root cause analysis, severe maternal morbidity

Student Research Center,
Faculty of Nursing
and Midwifery, Isfahan
University of Medical
Science, Isfahan, Iran,
¹Department of Midwifery
and Reproductive Health,
Faculty of Nursing
and Midwifery, Isfahan
University of Medical
Science, Isfahan, Iran,
²Department of Obstetrics
and Gynecology, Faculty
of Medicine, Isfahan
University of Medical
Science, Isfahan, Iran

Address for correspondence:

Marjan Beigi,
Department of Midwifery
and Reproductive Health,
Isfahan University of
Medical Science, Isfahan,
Iran.
E-mail: beigi@nm.mui.ac.ir

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Introduction

Maternal mortality rate is recognized worldwide as one important indicator of health because this indicator is used to evaluate the quality of reproductive health-care and the development status of countries.^[1] Another satisfying and strategic indicator in this area is the index related to morbidity. Certainly, every woman who dies

from the direct and indirect consequences of pregnancy, many women experience life-threatening complications^[2] that raise many concerns for health professionals. The World Health Organization defines a person who has experienced severe maternal morbidity as a woman who is almost dead but has survived serious complications that occurred during pregnancy, childbirth or during the 42 days after childbirth.^[3] Severe maternal morbidity not only endangers the

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life of the woman, but the fetus or infant may also suffer the consequences of maternal mortality and morbidity, thus preventing severe maternal morbidity not only reduces maternal mortality but also improve the infant's health and well-being.^[2] According to one study in southeastern of Iran, the most common causes of near-miss cases were reported as following: Severe preeclampsia (27.3%), ectopic pregnancy (18.4%), and placental abruption (16.2%).^[4]

The near-miss approach helps to evaluate and improve the quality of services provided by the health system by identifying the pattern of severe maternal morbidity, strengths and weaknesses of the referral system and available clinical interventions.^[5] Reporting maternal severe morbidity is the first step in determining the quality of maternal care. This report can serve as a complement to the confidential investigation of maternal deaths or as an alternative strategy to reduce maternal mortality.^[6] Data from severe Maternal morbidity are vital for policymakers to identify essential midwifery care. Findings of near-miss cases are a better indicator for the planning, monitoring, follow-up and evaluation of safe maternal programs in comparison with maternal mortality.^[7] Similarly, the World Health Organization recommended that high-income countries with low maternal mortality rates begin to investigate severe maternal morbidity in order to identify system failures and prioritize interventions.^[2]

Root cause analysis (RCA) is a review process and structured research that aims to retrospectively examine and identify the real causes of a particular outcome in order to determine preventive measures.^[1] RCA is beyond the investigation of human errors and emphasizes systems and processes rather than people's performance. Its purpose is to understand what happened and why it happened and what we can do to prevent it.^[8] The use of RCA as a way of continually quality improving provides the opportunity to create a patient safety culture. In Australia, RCA is used to improve methods of patient's practice and safety, facilitate teamwork and communication about patient care.^[9]

However, now, the only measure taken to improve maternal health in Isfahan and other provinces of the country is the examination of maternal deaths by conducting defect identification committees, which of course regardless of the root cause of any defect. Disregard to investigate maternal morbidity in these committees, as well as the failure to identify the roots of any defects in maternal mortality studies, have resulted in an increase in maternal morbidity, the morbidities that the concern about their occurrence is not less than maternal mortality due to their severe complications.

Investigation of maternal severe morbidity or near-miss cases can be used as a new and more useful

indicator for assessing the quality of maternal care services and as an effective strategy to reduce maternal mortality. Since in addition to more examination due to high morbidity rates comparing with mortality, it is possible to conduct interviews and obtain more accurate information about the mother, since she is alive. This study aimed to determine the root causes of severe maternal morbidity to introduce this analytical method to the universities' health and treatment administrative areas in order to be effective in improvement of maternal health.

Morbidity due to severe preeclampsia

A 34-year-old woman, having an unwanted third pregnancy with a history of stillbirth, has one child. Her contraceptive method was withdrawal; moreover, she did not receive prepregnancy care. Body mass index was 28. She also has a type 1 diabetes mellitus for 11 years and a history of hypothyroidism for 12 years and takes insulin and levothyroxine daily. She did not know about her pregnancy until 6 weeks of gestation, and after an abdominal and liver ultrasound to determine the cause of her pruritus, she became aware of her pregnancy. A gynecologist and an internist were referred for prenatal care; in addition, the mother's blood pressure was checked by a physician secretary. Also during pregnancy, despite high body mass index, no proper weight planning was planned and the mother gained 13 kg overweight. At the gestational age of 39 weeks and 5 days, she visits the hospital clinic for headaches. Due to hypertension 170/100 and blood glucose 207, she was immediately referred to maternity hospital. She was infused with magnesium sulfate. The first dose of hydralazine ampoule 5 mg was injected for the mother, and then 20 min later, the blood pressure was checked to be 160/100, the second dose of hydralazine was injected, which the blood pressure was 170/100 and then the third dose was injected that her blood pressure was 180/110. Eventually, the mother, with a diagnosis of severe preeclampsia and nonresponse to medication, was carried to operation room by wheelchair without internist counseling (to control blood sugar), and underwent emergency caesarean section, and the baby boy was born with a 9/10 Apgar score. After delivery, she was transferred to section of high-risk mothers; however, despite the history of diabetes, preeclampsia and emergency cesarean section, thromboembolic protocols are not performed for the mother. The mother is discharged after 4 days of hospitalization with medication instructions including insulin and methyl dopa. Despite receiving postpartum care and family planning counseling, her contraceptive method is currently withdrawal.

Morbidity due to uterine atony

A 35-year-old woman with a second and intended

pregnancy received partial prepregnancy care at the comprehensive health-care center without testing and follow-up by health-care personnel. She received prenatal care from the comprehensive health-care center. At 8 weeks gestation, the mother's platelet count was 129,000. The mother with gestational age of 39 weeks and 5 days with labor pain, reduced fetal movement and bloody show is admitted to maternity hospital. On arrival, the dilatation was 2–3 cm, effacement, 40%, and station-3. Fetal heart rate is monitored and reactive NST, negative CST, and biophysical score of 4/8 are reported. The mother is transferred to labor after 3 h of admission. On the same day, the female baby is born with a Thick meconium and weighing 3130 g and Apgar of 9/10. Episiotomy is repaired. Due to the neglect of patient's status in postpartum resulted from personnel shift change, the mother becomes severely hemorrhagic and the mother received partial uterine atony control protocols such as oxytocin and misoprostol with high dose. Due to uncontrolled bleeding and tachycardia (pulse 157), the mother is transferred to the operation room. The mother in the operating room received 3 units of pack cell, 4 units of FFP. A cookie-type Bakri balloon is fitted to the mother, and 6 pair of forceps are applied to the cervical wall. The mother is then subjected to cardiopulmonary monitoring and after controlling for bleeding, the forceps are removed and the Bakri balloon is automatically removed and excreted. Postpartum thromboembolic protocol did not apply to the mother, despite being over 35 years old, weighing more than 80 kg and blood and product injection. The mother is then discharged early after 4 days of hospitalization with a platelet count of 66,000 without any required training.

Morbidity due to systemic lupus erythematosus

A 31-year-old woman with a first and intended pregnancy had a history of lupus for 12 years, diabetes mellitus for 7 years, and hypothyroidism for 1 year. The mother received prepregnancy care by a gynecologist and did not referred to comprehensive health-care center. In prepregnancy care for nephropathy (24-hour urine protein, glomerular filtration, and albumin–creatinine ratio) had not been examined. During pregnancy, the mother was monitored by a gynecologist, endocrinologist, and rheumatologist, taking medications such as levothyroxine, hydroxychloroquine, aspirin, and insulin. During pregnancy despite diabetes mellitus, lupus, the thromboembolic protocol has not been implemented for the mother. Anomaly scan ultrasound at 19 weeks and 1 day of gestation revealed abnormal ultrasound of the fetal heart cavity and reported in the right and left ventricles of the fetal moving focus echogenesis and fetal bradycardia with a heart rate of 90. Then insufficient dexamethasone was prescribed by gynecologist. The mother is admitted to section of high-risk mothers at 25 weeks and 6 days of gestation

after being referred to the hospital for prenatal care due to high fasting blood sugar (FBS: 200). In the hospital, tests and consulting, rheumatology and endocrinology for the mother are requested and the mother's blood sugar was partially controlled by the drug, and the mother is discharged after 8 days of hospitalization with FBS of 150. About 1 month later, the mother, at 31 weeks and 5 days of gestation, complaining about reduced fetal movement referred to a gynecologist who, after ultrasound, discovered an intrauterine fetal death (IUFD). Three days later, the mother underwent cesarean section with IUFD diagnosis due to heart AV block3 and the fetus is removed. After delivery, postpartum thromboembolic protocol did not apply to the mother despite the history of illness and stillbirth. Six days later, the mother is discharged with prescription medications such as prednisolone, levothyroxine, and insulin. Currently, the mother has not been referred to a comprehensive health-care center for postpartum care due to not being explained, and her contraceptive method is a condom.

Morbidity due to postnatal thrombosis

A 37-year-old woman with a third and intended pregnancy had a history of 1 cesarean section, 1 curettage due to abortion, and an alive baby. She did prepregnancy and prenatal care at a gynecologist's office and did not go to a comprehensive health-care center. At 31 weeks and 4 days of gestation, she suffered preterm premature rupture of the membranes and referred to a treatment-training hospital. Examinations and ultrasound were required and betamethasone ampoules are injected to grow the fetal lungs. Four days later, the mother with gestational age of 32 weeks and 2 days with ultrasound diagnosis of oligohydramnios and Intrauterine Growth Restriction fetus underwent cesarean section and the baby is born with a 7/10 apgar score and 1450 weight. Postpartum thromboembolic protocol did not apply to the mother despite being over 35 years of age, multiparity, hospitalization, and immobility for more than 3 days. The mother is discharged from the hospital 3 days after childbirth without training for danger signs and symptoms of thrombosis; however, she had been referring to the hospital due to the infant's hospitalization in the neonatal intensive care unit. During this time, the mother complained of leg pain that eventually requested lower limb vein color Doppler ultrasound by a gynecologist that a severe thrombosis extended from posterior tibialis vein to superficial femoral vein and external iliac vein and joint iliac vein was evident. Spread of thrombosis to the small saphenous vein and deep femoral vein was also seen. After doing ultrasound, the mother complained of severe leg pain, swelling, and an ultrasound response, referred to treatment-training hospital 1, where there was not an internist, the catheterized mother was transferred to treatment-training hospital 2 by an ambulance with a

midwife and an intern without an anesthesiologist. The mother was admitted in section of high-risk mothers. During hospitalization, tests for the causes of thrombosis were not asked for the mother. Cardiovascular and internal counseling and medications including heparin for the mother was begun. Due to the maternal temperature rise, the mother's catheter was discontinued after 3 days, and the mother was finally discharged after 10 days of hospitalization with Prothrombin Time (PT): 15.10 and International Ratio (INR): 1.51 and warfarin medication instructions. After being discharged, the mother took warfarin tablets for 2 months and then discontinued under the doctor's advice. The mother did not go to a comprehensive health-care center for postpartum care. Her method of contraception was condoms.

Materials and Methods

The present study is a descriptive case series study. The list of high-risk mothers registered in Medical Care Monitoring Center in the first 6 months of 2018 were reviewed and maternal morbidity was purposefully divided in three categories of hemorrhagic disorders, hypertensive disorders and systemic disorders and then one sample from each group was randomly selected.

All four pregnant mothers in this study were from Alzahra Treatment-Training Center in Isfahan. Comprehensive health centers affiliated with Health Centers 1 and 2 were also prenatal care centers.

Data collection tools included hospital and health records of mothers with morbidity, interviews with mentioned mothers and their health-care staffs, reproductive profile questionnaire, and RCA checklist. Informed consent was obtained from research samples.

This checklist consisted of three sections: Health-treatment factors (factors related to human resources, structural factors related to equipment and structural factors for management and planning), family-social status, and maternal disease status. Factors related to human resources include 4 factors related to personality, psychological and physical characteristics of staff, communication and team, education and training, and task factors. Morbidity reports that were arranged in form of story through records review and interviews with mothers and 14 health-care staffs; moreover, they were evaluated and analyzed using the RCA method during multiple sessions by the method of focus group discussions with presence the RCA team. The team consisted of a gynecologist, a faculty member of midwifery, and the authors of the article. The content of the sessions was read as a morbidity report, identifying morbidity related deficiencies based on checklists and

brainstorming, and analyzing for these causes with the five whys tool. In a way that, by identifying any service deficiencies in the field of health and care, the whys of that deficiency were declared by the root analysis team until they were ended with the final and root cause for each deficiency. It should be noted that the reasons and causes related to each of whys were considered after the discussion of these members. In fact, the final obtained roots of any defects were as a result of the analysis performed by the root analysis team on the obtained whys from defects related to each morbidity. Finally, the suggested solutions and final report were set.

Results

In root cause analyzing of four cases of maternal morbidity, some of the most important deficiencies were identified as follows:

Factors related to health-care services: Inadequate knowledge and skills of service providers, lack of accountability of physicians and staff, disregard to protocols and guidelines, weakness in teamworking, poor quality family planning services, lack of follow-up system of high-risk patients after discharge, the lack of an integrated system for interaction between specialists and comprehensive health-care centers.

Factors related to disease status: Concurrent underlying diseases, chronicity of disease, lack of appropriate clinics for reproductive health care in women with underlying disease, lack of attention by physicians to providing healthy reproductive services.

Among factors related to family and social status, causes such as lack of patient and family referral to comprehensive health-care centers and lack of patient support by family are considered.

Based on these results, human factors related to health-care service were identified as one of the most important service deficits related to the maternal morbidity.

The most important obtained roots of the deficiencies, according to the root analysis team, in the field of health-care services include inadequate supervision of the educational and scientific processes of service providers from the area of deputy education, lack of an effective monitoring system for the professional evaluation of physicians, lack of midwifery supervisor to oversee the delivery of services to pregnant women, lack of supervision of authorities on using protocols by physicians and staff, lack of supervision of teamworking guidelines in hospitals, having several jobs and high volume of midwifery duties after health revolution plan implementation, inadequate

sensitivity of authorities towards maternal follow-up of high-risk mothers after discharge from hospital and lack of sensitivity among authorities to expedite launch of integrated electronic file system.

The obtained roots of disease status include lack of sensitivity among authorities to increase service coverage of prepregnancy care, lack of supervision by hospital authorities on appropriate patient care processes, lack of sensitivity among authorities to establish appropriate clinics for patients with underlying disease.

The obtained roots of family and social status consist failure of authorities to use community-based strategies to inform community members about the type and method of care available in comprehensive health-care centers, inadequate justification of the patient by hospital care providers for the need to receive postnatal care and healthy reproductive services.

Discussion

In the analysis of the four cases of maternal morbidity in this study, it seems that maternal morbidity related factors are increasing in recent years, which may be due to the lack of consideration of authorities on maternal morbidity committees. Because most of the focus is on specialized maternal mortality committees.

Results of this study showed that health system led to severe maternal morbidity more than other factors and human resources in the structure of health-care services (service providers) has important role in morbidity outcome. Human resources both due to insufficient knowledge, skills and profession in the field of science and lack of compliance medical and disregarded to hospital guidelines and protocols, and lack of necessary co-operation to implement teamwork protocols and advisory committees and as well going beyond their qualification regulation bound can lead to errors. That one of the main causes is human errors due to management deficiencies at ministry and university and hospital levels.

What is considerable in this study is that, despite the different morbidities, their root defects and causes are the same. Therefore, it is necessary to modify management and systematic processes. Several studies are in line with the results of our study, which are as follows:

Mahmood *et al.* (2018) in Indonesia acknowledged that the reasons for nonstandard care resulting from root analysis primarily are due to inadequate skills of service providers, poor use of protocols and guidelines, delay in identifying emergencies and subsequent delays in referral and care.^[10]

Okonofua *et al.* noted in their study results that in-service education and retraining of health-care providers should be incorporated into national policies and programs in order to prevent maternal mortality in referral centers in the country.^[11]

Wong *et al.* in their study results declared that the Chinese Women's Health Ambassadors Program helps empower disadvantaged women to reflect on the importance of health, take responsibility for their own health, and seriously promote the health of their families and personal communities.^[12]

Based on the findings of Mahmood and Okonofua, Wong *et al.*, and the present study, it is estimated that by taking interventions in to accounts such as stabilizing individuals in their occupations with the most skill and knowledge, achieving a robust alerting system for identifying and following mothers, benefits of Health Ambassadors' services in addition to collective strategies minimize the quality reduction of health service during pregnancy and improve health and therapeutic processes to prevent morbidity.

Bahreini *et al.* pointed out in the results of their study the important role of human resources in the better implementation and control of effective health-care processes and emphasized providing an appropriate environment for enhancing job performance and minimizing their errors through planning of managers and authorities that are needed to improve maternal health, reduce maternal mortality and morbidity in mothers and infants.^[13]

Riley *et al.* emphasized the formation of an interdisciplinary team of professionals, extensive teamwork training, a multiplicity of integrated strategies instead of a single intervention to achieve high reliability in obstetrics and gynecology.^[14]

Portela *et al.* stated in the results of their study that creating conditions for inter professional work groups, better communication and coordination, improving system member accountability, investing in technical competence of team members, and coordination of organizational structures and processes, all together can help improve the quality of women and pregnancy care.^[15]

According to the results of Bahreini, Riley, and Portela studies, and the present study, it is estimated that lack of management in planning of managers and managerial errors at the academic and ministry levels, including inadequate supervision of physicians' training and lack of teamworking and lack of collaborative common management plans among the medical and obstetrical

services have resulted in preventable errors and require targeted policies and effective interventions.

Concerning the factors related to the disease status, it is concluded in this study that many mothers with morbidity had previous underlying disease that caused or exacerbated the complications of pregnancy and childbirth. As we are now more exposed to the phenomenon of pregnancy in older ages (late marriage-the policy of encouraging childbearing), the likelihood of maternal morbidity with chronic illness also increases.

Shahidi *et al.*, by emphasizing the beneficial effects of prepregnancy care on certain pregnancy and delivery indicators, particularly cesarean and underlying diseases that threaten maternal health and result in a high percentage of maternal mortality recommended planning for the quantitative development of these cares; moreover, the need for quality improvement of these cares was through constant monitoring of staff and providing interventional strategies.^[16]

Based on the results of the mentioned study, it is estimated that the lack of formulation of care processes for women with underlying disease in their reproductive ages has led to errors. As noted by Shahidi *et al.* that increasing coverage of prepregnancy counseling can lead to the health of women with underlying disease.

The impact of factors related to family and social status was lower in this study so that in none of the morbidity cases, inadequate number of prenatal care was not evident. That reflects the relative awareness of families to receive pregnancy care services and access to the health system. Nevertheless, families' neglect was evident in the lack of pre-pregnancy counseling and care, which may be due to not introducing the importance of doing this care by health-care system policy makers. Mir *et al.* and Janani *et al.* in their study results stated that mass media and social media can be used to inform families, including spouses, about the complications of pregnancy and to help decision-making in families.^[17,18]

Considering the results of the present study and all the studies mentioned in this article, some of the most important suggested solutions are as follows: Improving the skill and knowledge of health-care staff by coordinating health and treatment administrative areas with education areas, developing management protocols such as teamwork protocol and advisory committees in hospitals by treatment center, and promoting families' awareness of the importance of using the services of health-care centers by mass media.

Conclusion

Based on the results of this study, human resources in the structure of the health system is the most important factor in creating maternal morbidity. Therefore, it is necessary to have capable and skilled human factor to do the qualified services and having sensitivity in the reduction of maternal morbidity and mortality. Therefore, health executors and policy maker should also realistically find the roots of all errors and focus on upgrading and managing the system rather than focusing on individuals, and focus on improving the services of these staffs. Thus, according to the results of this analysis, maternal health professionals in the field of health care and treatment as well as health-care providers and managers and public health authorities in the perinatal field can undertake a root analysis of maternal morbidity and mortality in order to prevent similar errors occurrence.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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