

Investigation of the causes of maternal mortality using root cause analysis in Isfahan, Iran in 2013-2014

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ABSTRACT

Background: Many maternal deaths caused are due to preventable causes during pregnancy and childbirth. Therefore, the detailed analysis of the root causes provides developing a plan and appropriate interventions to prevent these deaths occurring in the health system. This study aims to determine the causes of maternal mortality using root cause analysis (RCA) method.

Materials and Methods: This research is a descriptive explorative study. The data were collected from the files in the maternal health center and the interviews conducted with relevant personnel. The causes of maternal mortality and related reasons were determined by experts' team opinions and through a standard checklist of RCA. Causes consisted of the factors related to health services (human factors and structural factors), maternal family and social status, and maternal disease status. For each of these factors, analysis was performed to determine the root. In the end, interventional suggestions were developed to prevent the recurrence of similar deaths.

Results: Causes were classified into human factors, and structural factors in the area of planning and management and social status of mothers. The results showed that human factors were composed of lack of knowledge and skills in the medical team, unfamiliarity with their duties, lack of health care-based on protocols, etc. Structural factors included lack of follow-up after discharge and inadequate supervision of inspectors on academic qualified doctors. Maternal social and family status factor included lack of referral the mothers' to the health care center.

Conclusions: Based on the RCA process, the most fundamental factor in creating these deaths was management errors at the level of universities and the Ministry of Health. These errors included inadequate supervision of medical education, failure to identify and introduce the instructions and guidelines related to the care of pregnant mothers by the health workers and experts, and lack of collective strategies to inform the public about the type and model of self-care in health centers. Based on the obtained results, the solutions proposed for elimination of root causes of maternal death are organizing sequential training courses tailored for the staff taking care of pregnant women, sending guidelines related to maternal health care to all private and public institutions, and informing the community to receive health care services by health centers and mass media.

Key words: Iran, maternal mortality, pregnancy, root cause analysis

INTRODUCTION

Pregnant women's mortality due to pregnancy and delivery complications is one of the most important and well-known indexes indicating the economic

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and cultural development and health care system in a country.^[1] Based on the third Millennium Development Goal of the United Nations, this ratio should be decreased by 75% and return to the basic level in 1990 by 2015. This index is an average of 200 in developing countries and in developed countries, it is 20 out of 100,000 live births.^[2] In this report, the maternal mortality index is 30 out of 100,000.^[3] The difference in this type of mortality in developed and developing countries is more observable than any other health problem, while 25% of the women at fertility age live in developed countries and only 1% of mortality cases occur in such countries.^[2] Maternal deaths at national and international levels include all types of deaths of women during pregnancy or during 42 days after delivery, regardless of the length and location of pregnancy and due to any reason that is related to or worsened by the pregnancy.^[4] It, typically, does not include the deaths due to other reason such as car accidents or violence during the pregnancy period.^[5] Maternal death is a catastrophic

event at all times in the health care systems.^[6] The family misses a basic element of management and leads to an unclear condition of the child's survival and education after mother's death.^[7] Therefore, the efforts to reduce and prevent repetition of such deaths are of great importance to promote children's health. Islamic Republic of Iran has fortunately been introduced as one of the most successful countries in achievement of reduction in maternal deaths, but the concern still exists for similar cases of mortality due to repeatable events of death in equal conditions and the incomplete prevention despite the hard efforts of experts.^[8] This latter issue needs investigation to clarify the roots more precisely. The clinical governance is a comprehensive and new mechanism to investigate the causes deeply and more precisely to improve the quality of services progressively and obey the possible standards, which result in prevention of deaths or disability. In this system in which risk management is a pivotal axis, the emphasis is on preventive methods and root cause analysis (RCA).^[9] RCA is a structured process of investigation and research which aims at retrospective reviews^[10] and recognition of real causes of a specific outcome,^[11] seeking for solutions to delete these causes.

This type of analysis helps us know what happened, how it happened, why it happened, and consequently, helps detection, modification, and deletion of similar events in future.^[12] It seems that investigation of maternal death and suggestion of interventional strategies with such an accurate and precise method can reduce the maternal mortality and morbidity that result from preventable causes during pregnancy and delivery and, consequently, the bitter tragedy of maternal death and the remaining children can be ended. A case of maternal death out of hospital due to emboli which resulted from venous thrombosis is discussed in the present study. With regard to clear and definite strategies and policies of the universities to increase physicians' and midwives' knowledge in relation with promotions of pregnant women's health, this mother's death, which resulted from a general physician's wrong diagnosis and not referring the patient to a gynecologist, should be more deeply noted. RCA of this death to achieve interventional strategies can prevent occurrence of such deaths.

Death report

A 39-year-old pregnant woman, G₃P₂L₂, residing in Isfahan died at home due to thromboembolic event in January 8, 2013.

Before pregnancy

Her previous deliveries were in cesarean section mode and there were no specific diseases from which she or her family was suffering (based on her husband's explanation).

She used to refer to a private general physician from 2010 for any health care she needed. In March 2012, she referred to a doctor due to metrorrhagia, and in the requested sonography, her uterus was reported to be larger than normal with normal ovaries. Yasmin pills were prescribed for her. After 3 days, Medroxyprogesterone was prescribed for her due to her intolerance to the previous tablet (Yasmin pills). She asked her physician to prescribe fertility methods for her. For maternal care, venereal disease research laboratory test (VDRL) and blood urea nitrogen/creatinine (BUN/Cr) were requested for her. About 1.5 month later, the physician prescribed clomiphene tablet and requested an abdominal sonography after 8 days, and then, a vaginal sonography after 3 days in which the uterus was found to be bigger than the normal size and the endometrium thickness was 14 mm (irregular) with normal ovaries. Five follicles (13–13.9 mm) were observed in the ovaries, and the physician prescribed human chorionic gonadotropin (HCG) ampule for her.

Pregnancy

On obtaining a positive report of pregnancy, two sonography tests with a 2-week interval were conducted. During routine care at 8 weeks of gestational age, the third vaginal sonography was requested to determine the gestational age and Fetal heart rate (FHR) status. Next day, the patient referred to an orthopedic surgery clinic due to a unilateral progressive pain in her left leg that had started 3 days before (based on her husband's explanation), and the orthopedist prescribed diclofenac gel after performing a physical exam which led to the diagnosis of a spasm. He also suggested her to refer to her physician. On the same day in the evening, she referred to her GP, and as his office was crowded, she referred to another physician in the same center who prescribed two piroxicam injections. Immediately after taking injections, the patient referred to her own GP, and he recommended heating up the leg in pain and resting. Based on existing evidences, the physician requested U/A, U/C, and vaginal sonography. At 9 weeks of gestational age and at 21:32 hours, the emergency team was called as the patient had cyanosis and respiratory distress; at 21:44 hours, the emergency staff attended the patient at home, intubated her, and administered cardiopulmonary resuscitation (CPR) for 20 min. They transferred the patient to the hospital, where on arrival (22:35 hours), the patient had no vital signs with a mydriasis. As the patient was pregnant, CPR was continued with no success, and finally, her death was reported.

MATERIALS AND METHODS

This research is a descriptive case study. The required data were collected by referring to the expired mother's medical file existing in the related health care center in Isfahan and

by interviewing the related staff. Data collection tool was a researcher-made checklist of RCA of the death, which was designed with the help of clinical governing office in the Ministry of Health, Treatment, and Medical Education. This checklist has three sections of health and treatment factors, disease status, and socio-familial status. Health and treatment factors include human resources, structural factors related to equipment, and structural factors related to management and planning.

Human resources related factors contain four factors (individual status, communications and team, education, and task-related factors). As some qualitative and quantitative changes were made in the checklist of clinical governing office in the Ministry of Health, Treatment, and Medical Education, and the checklist was researcher made, validity of the checklist was checked by some academic members of Isfahan University of Medical Sciences (academic members of gynecology and midwifery department). Data were evaluated and analyzed by RCA method during several focus group discussions in the presence of RCA team members. This team comprised a gynecologist, an obstetrician, an academic member of midwifery department, and the authors of this article. The agenda of the sessions included reading the death report, determination of death-related factors based on the checklist and brainstorming, and analysis of these factors with the tool of five whys.

In this type of analysis, after approval of each defect, the root causes are detected by asking several whys, and in this way, all problems are basically and deeply investigated. At the end, the suggested strategies are designed and the report is finalized.

RESULTS

Demographic characteristics of the expired mother were: Age 39 years, living in urban area, was a homemaker with high school education, had three pregnancies with two live births, previous deliveries in cesarean section mode, locations of receiving health care (in a health care clinic and a private office), and occurrence of death at home.

After going through the case and with the help of the checklist and brainstorming, the following factors were revealed:

- Treatment services related factors (hospital services) and health-related factors (health care center and private office care services): Human factors:

Personal conditions: The defects in this item were:

- Physician's high self-confidence or illogically high self-confidence (conducting maternal prenatal counseling and care without consideration of the

protocols of reference books); worst of all, the physician believed the care was perfect

- High risk taking by the physician (giving services such as prescribing fertility assistive medication whose side effect and control are not indicated in general physicians' job description).

Education and learning

The related defects were:

- Physician's inadequate knowledge and skill [not diagnosing deep vein thrombosis (DVT) that resulted from carelessness in GP's physical exam and the orthopedist's exam]
- Unfamiliarity of the physician with his job description and not passing essential continuing education courses based on current conditions and cases.

Duty (administration of no care based on the protocols and instructions issued by the Ministry of Health).

- Physician's administration of care and counseling not based on protocols
- Physician not referring to instructions due to their unavailability
- Physician not recording the data in patient's health records
- No obedience to referral system (the patient with several risk factors such as age over 35 years, usage of fertility assistive methods for pregnancy, and history of two cesarean sections needs to be referred to a gynecologist, based on the protocol, which was not considered by the physician).

Structural factors: (Equipment, management, and planning)

Managerial and planning structure:

- Lack of a patients' follow-up system after discharge
- Inadequate supervision of inspectors on scientific capability and the given services as well as the quality of general physicians' visit to the patients in their offices

- Disease status:

In this death report, there was no defect found concerning the expired mother's disease.

- The socio-familial factors:

Lack of patient's referral to health care center to receive maternal and prenatal care (no prenatal counseling, an offence to the existing protocol).

DISCUSSION AND ANALYSES

In the present study, mother's age, number of pregnancies, and the location of receiving prenatal care were associated

with the complications observed. An investigation on maternal death causes in Semnan showed that having a high age, administration of Cesarean section (CS) in pregnancy, and being multiparous were among the risk factors for maternal deaths.^[13] Farrokheslamlo *et al.* reported that the risk of death due to pregnancy and delivery complications was associated with mothers' age in such a way that at ages over 40 years, the ratio was 4.6-folds more, compared to age 20–24 years.^[2]

RCA of the team in relation to the factors associated with maternal mortality gave the following findings:

- Physician's high risk taking (giving services whose control was not in his job description, including prescription of fertility assistive medication), why? Urging the patient to permanently refer to his office, why? A reduction in patients who refer to GP's offices, why? Shift of majority of the patients to specialists' offices, why? Public belief on low knowledge of GPs, why? Not introducing the GPs as the first level of screening of health and treatment system to public, why? Not conducting the family physician plan, why? Lack of appropriate planning to administer family physician plan
- General physician's illogical excessive self-confidence [conducting maternal and prenatal care counseling, regardless of instructions and professional reference books (while the physician believed the prenatal care was perfect)], why? Lack of physician's knowledge and awareness of his high-risk patient, why? Physician's inadequate knowledge in his field of profession and about the instructions related to pregnant mothers, why?
- Lack of physician's awareness of the instructions related to pregnant mothers, why? Lack of detection and introducing these guidelines from the side of health and treatment experts to GPs, gynecologists, and midwives
- Lack of supervision on the quality of care given by physicians, why?

Lack of existing scientific checklists for monitoring and evaluation, why? Absence of a national inspection system to supervise physicians' scientific activities.

Absence of obedience to referral system (patient had several risk factors such as age over 35 years, usage of fertility assistive methods, and history of two previous cesarean sections. Therefore, based on the guideline, she should have been referred to a gynecologist, but this was not done by the physician), why?

- Not knowing about the obligatory process of referral system, why? Absence of passing information to the GP by official inspectors

- Fear to miss a patient, why? GP's financial problems, why? Absence of GP's visits payment modification by the Ministry of Health, Treatment, and Medical Education and the Medical Council, why? Absence of GP's support, made by Medical Council and Ministry of Health, Treatment, and Medical Education, why? Absence of administration of family physician project.

Absence of appropriate supervision on physician's scientific capability in his office, why? Insufficient scientific capability of the inspectors, why? Lack of trained inspector for evaluation, why? Problems related to financial payments to inspector, why? Indifference of the authorities to consideration of a specific budget to hire trained forces for precise inspection

- Unfamiliarity of GPs with their job description, why? Absence of an informatics system in official domains, the Medical Council, and GP's scientific associations, why? Insufficient supervision of these three domains on GP's treatment activities, why? Insufficient supervision on GP's scientific visits of the patients
- Inadequate GP's knowledge and skill (in diagnosis of DVT due to inadequate skill of the GP and the orthopedist in administration of physical exam), why?
- Not enough professional commitment of physicians, why? Indifference of physicians during their education, why? Health indexes protocols not included in education
- Absence of an appropriate educational background, why? High number of admitted students in each semester, why? Absence of appropriate planning to admit students by the vice chancellor for education in the Ministry of Health and Medical Education
- Inadequate supervision on physicians' education during their professional life (continuing education is not obligatory based on the emergency cases, priorities, and health indexes. The participant can obtain the needed score by attending any professional education), why? Continuing education staffs in continuing education offices ignoring the physicians' viewpoints concerning the outline of continuing education, why? Inappropriate needs assessment made in official domain.

GP's no patients' follow-up after discharge, why?

- Lack of follow-up after discharge, why? Inadequate attention paid to importance of having such a system in university
- Absence of proper education of patients that is related to diseases' possible outcomes, why? GPs' wrong diagnosis, why? Lack of knowledge and awareness.

Not referring to health care files to record information, why?

- Lack of physicians' awareness of obligatory recording of the patients evidences, why? Lack of information about the offence of not recording the evidences, why? Not sending medical errors from the Medical Council to physicians (complaints are referred to this organization), why? Lack of attention of the authorities of this organization to physicians' occupational and professional condition
- Absence of inspectors' supervision on recording the information in patients' files by physicians, why? Inadequate attention of inspectors.

Based on the conducted analysis, factors such as not properly introducing the physicians as the first health and treatment system screening level to the public, followed by improper planning for family physician project, health and treatment experts not presenting the guidelines related to the pregnant mothers, absence of patients' follow-up system after discharge from a private office, authorities' insufficient attention paid to a specific budget to hire scientifically professional staff for inspection, improper planning in the Ministry of Health, Treatment, and Medical Education in fulfillment of physicians' educational problems during their education in university, including absence of a proper educational background, high number of student admission, and their low interest in obtaining knowledge, and finally, insufficient supervision on physicians' education during their occupational activities were detected as the root causes for defective services. Some studies have been presented in this regard in the following paragraph.

Dogba *et al.*, in a study on health care providers' and the staff's capability in rural areas, reported that as the notable part of first-line health care centers in rural areas has employed a physician who is the first screener, an organizational health care model in the domain of health and treatment services is needed to be established by the authorities.^[14] Farahi and Zolotor reported that the function of a family physician is very efficient in prenatal care, and counseling with hypertensive mothers or those with epilepsy or diabetes is in the family physician's job description.^[15] Munro *et al.* believe that a GP in a family physician team is adequate and acts perfectly for prenatal care in Canada.^[16] Herrera reported that the role of a family physician is very efficient in reduction of neonatal mortality which is one of the Third Millennium Goals.^[17]

In the present study, it was clarified that one of problems of the treatment system is absence of proper education of the patient concerning the risk factors that play a key role in maternal deaths. Meanwhile, it is usually ignored. Okereke *et al.* showed that in Nigeria, mothers' awareness of safe motherhood methods was poor among the Nigerian women in rural areas and enhancement of awareness concerning

safe motherhood results in better pregnancy outcomes and, consequently, lower maternal deaths in developing countries.^[18] Igberase *et al.* reported that health education programs to prevent maternal deaths and complications should be improved. Health education messages should include early diagnosis of maternal death risk factors, modification of wrong beliefs, early record of prenatal care, and immediate referral to hospital in emergency cases of delivery.^[19] Majoko *et al.* reported that pregnant mothers' acceptance of midwives' recommendations concerning their referral when facing risk factors was low in such a way that many mothers did not refer to a health care center, despite the existence of risk factors. Meanwhile, some mothers referred only when the signs were quite similar to the mentioned risk factors.^[20] Goli and Jaleel showed that the quality of health care given in health centers was important in reduction of maternal deaths and receiving complete prenatal care increases the chance of maternal survival.^[21] Ngongo *et al.* showed that delivery centers should be managed by clear clinical decisions making guidelines. Guidelines should be adequately available to individuals to develop accountability.^[22] Luitjes *et al.* reported that to improve care, an appropriate insight should be made to apply clinical guidelines in daily function. These guidelines should also have valid quality indexes to be supported and followed.^[23] Clark's study that was conducted on maternal death reduction strategies showed that comprehensive programs such as reduction of variety in provision of care through use of guidelines, using a checklist in patients' management instead of relying on memory, and modification of medical errors are efficient in maternal death reduction.^[24] Gidardina *et al.*, in a study on the root causes of delayed diagnosis and treatment of outpatients, showed that inadequate planning for follow-up and lack of a patients' follow-up system were among the most commonly reported efficient factors.^[25] Shen *et al.* reported that the government should play an active role in reduction of mortality and its related factors.^[26]

Root analysis of the related team with regard to maternal mortality gave the following findings:

- Lack of patient's referral to health care centers for maternal and prenatal care (lack of counseling before pregnancy based on the existing protocol), why?
- Patient's or her family's inadequate awareness of the health care given in the health center
- Lack of patient's family's trust in the services given in health centers, why? Not using collective strategies to inform public in relation with the type and manner of care presented in the health care centers. Informing the families and educating the individuals concerning the health issues can play an effective role in maternal death control. Lewycka *et al.* showed that community mobilization through women's groups volunteers

and conducting education through these people are among the methods to improve maternal outcomes in a rural population in the USA.^[27]

CONCLUSIONS

During the investigating process, the most important defects of the above-mentioned case were found to be associated with human and structural factors from the groups of factors associated with health and treatment factors, while their root causes were managerial errors. It seems that the following interventional strategies can modify the managerial process and prevent such deaths.

In the domain of health and treatment management, the following issues should be considered: Forcing the mass media to transfer health and care education to the public and informing the families about the importance of their benefit from health care centers, standardization of health care services for mothers in the private sector (outpatients), family physician project, conducting educational needs assessment based on maternal death or postpartum disabilities and holding sequential continuing education related to maternal care, consideration of a follow-up system in health and treatment levels to monitor the pregnant women precisely, informing the staff in private and governmental centers about the necessity of health care files to record patients' evidences, sensitization of the Medical Council and physicians' scientific associations and midwives toward maternal death prevention, preparation of periodical case reports of the existing complaints in the Medical Council and publishing them in scientific bulletins to send them to physicians' and midwives' private offices.

In the domain of educational services management, the following issues should be considered: Adequate attention to be paid to medical students' education and proper measurement of their obtained skills, decreasing the number of students to an appropriate number to improve educational quality, and including health indexes protocol education.

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