

Root cause analysis of maternal deaths at Dr. Soetomo General Academic Hospital Surabaya, Indonesia in 2019



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ABSTRACT

Introduction: Maternal mortality in Indonesia especially in Dr. Soetomo General Hospital is still very high, and the biggest problem is obstetric complications. It is possible that the mother who has obstetric complications is safe and recovered or died. This study aimed to identify the root cause of maternal death at Dr. Soetomo General Academic Hospital in 2019.

Methods: This is a descriptive retrospective study with the Root Cause Analysis method to analyze total of 87 maternal deaths at Dr. Soetomo General Academic Hospital in 2019.

Results: There were 87 cases of maternal death at Dr. Soetomo General Academic Hospital in 2019. Direct maternal death was the leading cause of maternal death, contributing 59 cases (67.8%). From 59 cases, 31 cases (35.6%) direct maternal deaths were caused by preeclampsia/eclampsia. Contributing factors that influence maternal mortality are including organizational management, medical personnel, equipment, materials, & ward, environmental, and family barriers factors. Organizational management factors, the most common factor that causes maternal death is a poor information sharing system at the referring hospital, as many as 17 cases (27.4%). Medical personnel factors, maternal death was mostly caused by lack of knowledge and skills during antenatal care, as many as 42 cases (44.2%). Equipment, materials, and ward factors, the most common cause was the unavailability of the ward, contributing 5 cases (5.6%). Family barrier factors, most maternal deaths were caused by the families that did not understand about the emergency condition of the patient, as many as 52 cases (67.5%).

Conclusion: The maternal deaths at Dr. Soetomo General Academic Hospital in 2019 were mostly caused by the family barrier factor which did not understand about patient's emergency condition, followed by the medical personnel factor which was lack of knowledge and skills during antenatal care.

Keywords: Maternal death, root cause analysis, eclampsia, preeclampsia.

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INTRODUCTION

The maternal mortality rate is an indicator of a country's health services quality. High maternal mortality indicates a low quality of health in a country, and it is one of the indicators to see the results of public health programs.¹ The maternal mortality ratio in developing countries in 2015 was 239 per 100.000 live births and 12 per 100.000 live births in developed countries. The World Health Organization (WHO) set Sustainable Development Goals (SDGs), with a target of reducing the number of global maternal deaths by 2030 below 70 per 100.000 live births.²

The maternal mortality rate (MMR) in Indonesia was 305 per 100.000 live births

in 2015, 89.81 per 100.000 live births in East Java in 2019, and 72.99 per 100.000 live births in Surabaya in 2018. In East Java, there were 520 maternal deaths and 566.300 live births in 2019. Meanwhile, the number of maternal deaths in Dr. Soetomo General Academic Hospital Surabaya in 2019 was 87 cases.²

Root Cause Analysis (RCA) is a structured analysis method that identifies the root cause of an event. It is sufficient to prevent the recurrence of the same incident. With RCA, we can find answers to the questions "What happened?", "Why did this happen?", "What should have happened?", and "What can be done to prevent the same incident?" which aims to find the root cause of the problem and find

a suitable solution.³

RCA is quite often used in hospitals as a method of identifying the causes of maternal deaths, postoperative complications, and medication errors. RCA is believed to be able to reduce the occurrence of unexpected events. RCA can provide a better solution, not only "A can cause B" but "by changing A, the possibility of recurrence of B can be reduced or prevented". So it is important to study RCA for health service providers.⁴

Dr. Soetomo General Academic Hospital is a type A hospital which is located in Surabaya, Indonesia occupying 163.874 m² area with the capacity of 1505 beds.⁵ As one of the biggest hospital in Indonesia, Dr. Soetomo General Academic

Table 1. Number of maternal deaths based on the causes of maternal deaths.

Causes of Maternal Deaths	Number of cases	Number of Contributing Factors	Contributing Factors			
			Organizational Management Factors	Medical Personnel	Equipment, Materials, and Ward	Family Barriers
Direct						
Post Partum Bleeding	7 (8%)	17	5	7	2	3
AFLP	5 (5.7%)	11	2	5	-	4
Preeclampsia / Eclampsia	31 (35.6%)	72	18	28	3	23
Sepsis	8 (9.2%)	16	5	6	1	4
Congenital Heart Disease	8 (9.2%)	20	6	7	1	6
Indirect						
Autoimmune/SLE	3 (3.4%)	6	2	1	-	3
Lung Tuberculosis	2 (2.3%)	5	1	2	-	2
Pneumonia	3 (3.4%)	4	2	1	-	1
Beta Thalasemia	1 (1.1%)	3	1	1	-	1
Morbus Hansen	1 (1.1%)	2	-	1	-	1
Iron Deficiency Anemia	1 (1.1%)	3	1	1	-	1
Bacterial Meningitis	1 (1.1%)	2	1	1	-	-
Meningoencephalitis Tuberculosis	2 (2.3%)	4	1	2	1	-
Airway Aspiration	1 (1.1%)	2	-	1	-	1
Cervical Cancer	1 (1.1%)	2	-	1	-	1
Rectal Cancer	1 (1.1%)	2	-	1	-	1
Breast Cancer	1 (1.1%)	2	-	1	-	1
Thyroid Cancer	1 (1.1%)	3	1	1	-	1
Thyroid Storm	2 (2.3%)	4	1	1	-	2
Anaphylactic Shock	1 (1.1%)	2	1	1	-	-
Intracerebral Hemorrhage	2 (2.3%)	3	1	1	1	-
Stroke, Subarachnoid Hemorrhage						
HIV	2 (2.3%)	2	-	-	-	11
Refractory Hypokalemia	2 (2.3%)	4	1	2	-	1

Hospital is being the top referral hospital in Eastern Indonesia which receives referrals from satellite hospitals, especially East Java Province. In this study, 87 cases of maternal death in Dr. Soetomo General Academic Hospital had been analyzed using the RCA method to find out the root cause of the problem to prevent the recurrence of the same incident in the future.

This study aimed to identify the root cause of maternal death at Dr. Soetomo General Academic Hospital in 2019.

METHODS

Study Design

This research is a descriptive retrospective study that analyzed maternal deaths with Root Cause Analysis method using 5-Whys analysis. This research was conducted at Dr. Soetomo General Academic Hospital

Surabaya during January-February 2021.

Data Collection

The data collection and processing was carried out from the time it was approved by the Ethics Committee until it was completed. The research data was collected through the medical records of pregnant women who were treated and died at Dr. Soetomo General Academic Hospital Surabaya in 2019, then anonymized and coded. This study collected variables regarding the root cause of maternal death, namely organizational management factors, medical personnel, equipment, materials, & ward, environment, and family barrier factors.

Data Analysis

The data was then analyzed by RCA team using 5-Whys analysis. The RCA team consisted of 1 researcher, 2 senior doctors,

and 2 resident doctors was formed to discuss the root causes of maternal deaths in Dr. Soetomo General Academic Hospital.

RESULTS

Eighty-seven death were identified in 2019. This is believed to represent complete ascertainment of direct and indirect maternal deaths in Dr. Soetomo General Academic Hospital over this time period. The cause of the 87 deaths are presented in [table 1](#). Preeclampsia/eclampsia was the immediate cause of death for 35.6% of the deaths.

The finding of the retrospective review of contributing factors are shown in [table 2](#). As much as 88.5% of the cases are caused by more than one contributing factors. The contributing factors are organizational management factors,

Table 2. Number of maternal mortality based on contributing factors.

Contributing Factors	Number of Contributing Factors	Maternal Mortality Cause	
		Direct	Indirect
Organizational Management			
Poor management at the satellite hospital	1 (1.1%)	1	-
Poor management at Dr. Soetomo General Academic Hospital	1 (1.1 %)	-	1
Lack of protocol at the satellite hospital	5 (5.7 %)	5	-
Lack of protocol at Dr. Soetomo General Academic Hospital	3 (3.3 %)	1	2
Inadequate staff at the satellite hospital	1 (1.1 %)	-	1
Inadequate staff at Dr. Soetomo General Academic Hospital	1 (1.1 %)	1	-
Failure/delay in emergency treatment at the satellite hospital	13 (14.9 %)	10	3
Failure/delay in emergency treatment at Dr. Soetomo General Academic Hospital	2 (2.2 %)	-	2
Procedural delay at the satellite hospital	1 (1.1 %)	-	1
Procedural delay at Dr. Soetomo General Academic Hospital	6 (6.9 %)	2	4
Poor information sharing system at the satellite hospital	17 (19.5 %)	13	4
Poor information sharing system at Dr. Soetomo General Academic Hospital	4 (4.4 %)	2	2
Delay in accessing laboratory results	-	-	-
Pyramid of referral	7 (7.7 %)	6	1
Medical Personnel			
Lack of knowledge and skill during antenatal care	42 (48.3 %)	31	11
Lack of knowledge and skill at the satellite hospital	17 (19.5 %)	12	5
Lack of knowledge and skill at Dr. Soetomo General Academic Hospital	2 (2.2 %)	1	1
Delay in making decision during emergency at the satellite hospital	-	-	-
Delay in making decision during emergency at Dr. Soetomo General Academic Hospital	1 (1.1%)	-	1
Poor communication among medical personnel at the satellite hospital	9 (10.3 %)	8	1
Poor communication among medical personnel Dr. Soetomo	1 (1.1%)	1	-
Failure to seek help at the satellite hospital	2 (2.2 %)	2	-
Failure to seek help at Dr. Soetomo General Academic Hospital	-	-	-
Inadequate treatment during antenatal care	6 (6.9 %)	5	1
Inadequate treatment at the satellite hospital	11 (12.6 %)	9	2
Inadequate treatment at Dr. Soetomo General Academic Hospital	4 (4.4 %)	2	2
Equipment, Materials, and Ward			
Equipment and materials	4 (4.4 %)	2	2

Contributing Factors	Number of Contributing Factors	Maternal Mortality Cause	
		Direct	Indirect
Ward (the availability of ICU, NICU, isolation room)	5 (5.7 %)	5	-
Environment	-		
Geography	-	-	-
Family Barriers			
Families that did not understand about patient's emergency condition	52 (59.7 %)	36	16
Financial problem	5 (5.7 %)	2	3
Delayed antenatal care	20 (23 %)	14	6

medical personnel, equipment, materials, & ward, environment, and family barrier factors. The most influential contributing factor in maternal deaths was family barrier that did not understand about patient's emergency condition, contributing 59.7% of the deaths.

From the organizational management factors, the most common factor was poor information sharing system at the satellite hospital, contributing 17 cases (19.5%). Dr. Soetomo General Academic Hospital as type A and top referral hospital in Eastern Indonesia is obliged to receive all referral cases from satellite hospitals. Patients referred with untreated or not fully treated complications describe a poor organizational management at the satellite hospital.

From medical personnel factors, the most common factor was the lack of knowledge and skills during antenatal care, contributing to 42 cases (48.3%). In the cases caused by this factor, it was found that most medical personnel did not perform a good history taking and complete physical examination during antenatal care, thus it leads to a greater risk of inaccurate diagnosis and resulting wrong treatment. There was a case of maternal death caused by undetected congenital heart disease during antenatal care since the midwife did not do an auscultation.

In some cases, maternal deaths were also influenced by the unavailability of equipment, materials & ward, such as the unavailability of intravenous fluids, blood, CT-scans, ventilators, ICU, isolation rooms, and NICU. In this situation, a

Table 3. Root cause analysis of a maternal death case at Dr. Soetomo General Academic Hospital using 5-Whys methods

1. Why did the patient develop a cardiogenic shock?	-Because of the persistent severe hyperkalemia -Hyperkalemia correction had been done but not succeed
2. Why did the patient experience persistent severe hyperkalemia?	-Because the patient experienced renal injury -Because the patient had Multiple Organ Dysfunction Syndrome (MODS)
3. Why did the patient had MODS?	-Because the patient experienced acute liver failure. -Because the patient had Acute Fatty Liver of Pregnancy (AFLP)
4. Why did the patient have AFLP?	-The patient had a history of chronic hypertension superimposed by severe preeclampsia. -The patient came to obstetric outpatient clinic in the referring hospital on April 22 nd 2019 with a chief complaint of shortness of breath, but the Obgyn advised a termination on May 6 th 2019 (taken from verbal autopsy data) -The patient's laboratory examination result was not taken by her family.
5. Why did not the patient's family take the laboratory examination result?	-Because the patient and her family did not have a free time to take laboratory examination result (taken from verbal autopsy data), until her condition worsened on April 25 th 2019, she complained yellowish eyes and shortness of breath. -The patient was referred to Dr. Soetomo General Academic Hospital by the Obgyn in the referring hospital, but it took a long time to refer because the Resuscitation Room had reached full capacity. The patient took a long time to complete several administration requirements as a consent to be treated on extrahed.
<u>Contributing Factors of this case :</u>	
Organizational Management Factor : Procedural delay at Dr. Soetomo General Academic Hospital	
Medical Personnel Factor : Inadequate treatment at the referring hospital (the patient experienced shortness of breath but no action was taken)	
Family Barriers Factor : Did not understand about patient's emergency condition (patient and family did not take laboratory examination result).	

referral to secondary or tertiary hospital is required and the patient's chance of getting immediate treatment will be delayed.

From 87 maternal deaths at Dr. Soetomo General Academic Hospital, there were no deaths caused by environmental factor. The time needed to reach Dr. Soetomo General Academic Hospital from satellite

hospital were mostly less than 120 minutes. Geography factor did not seem to be a problem since there were already quite a lot transportation modes and highways.

From family barrier factors, the most common factor was families that did not understand about patient's emergency condition, contributing 52 cases (59.7%).

The lack of understanding about this condition was related to family cultural and education background. 25 patients (28.7%) were identified from 87 maternal deaths at Dr. Soetomo General Academic Hospital were senior high school graduates.

Table 3 provides an example of root cause analysis with 5-whys questions pointing to various factors that caused the patient's death.

DISCUSSION

This was a descriptive retrospective research with root cause analysis method. This research provided a comprehensive understanding about how organizational management, medical personnel, equipment, materials, wards, environments, and family barrier factors affected quality of care which resulted in maternal death. Our study combined various data collection tools including electronic medical record, verbal autopsy, and audit, which are effective to identify quality of care.⁶ This study highlighted not only the factors that contributed to 87 maternal deaths at Dr. Soetomo General Academic Hospital, but also the details of how each of those factors played a role. Family barrier and medical personnel factors played a role as a root cause of almost all the maternal deaths in this study.

Direct maternal death contributed to the majority of maternal mortality cases in Southeast Asian countries. In most developing countries, the direct causes of maternal deaths are post-partum hemorrhage, preeclampsia, and sepsis. This is in accordance with the results of the study that preeclampsia was the major cause of maternal deaths at Dr. Soetomo General Academic Hospital.⁷ In developed countries, preeclampsia can be managed well due to universal access to antenatal care, access to timely care, and proper management.⁸

More than half of the deaths in this study had some family barrier to get an adequate treatment in the health care, either because the patient and her family did not understand about the patient's emergency condition or postponed the early antenatal care. From our verbal autopsy, one of the patient's family claimed that pregnancy

is a common thing that did not need a regular monitoring of the mother and the baby. A patient with gravida 5 did not go to health care for antenatal care because her previous pregnancies were fine then she thought that antenatal care was unnecessary for her. Patients and their families still did not fully understand that there is no pregnancy without risk. There is a few probabilities that during pregnancy there was no risks found, but the danger can be developed at the time of delivery, which can cause maternal morbidity or even mortality for the mother or the baby.⁹ Another factor is the factor to make decisions that are influenced by culture, the decision to refer often has to be discussed with the extended family first, besides that the husband's factor also affects the health of pregnant women such as the desire to have how many children. Some of them also had a financial problem. The government actually had already given universal health coverage for all people in Indonesia, including pregnant women, but financial problem stated here was referred to transportation, lodging for the patient's companion, meal, and other expenses. One patient with two children refused to be referred due to emergency condition to secondary/tertiary hospital, not because of financial problem, but because she had no one to take care of her children at home. Pregnant women were given education about danger signs during antenatal care, but may not forward to her family. Health education material in local language should target family as well as pregnant woman.¹⁰

The factors causing maternal death were presented during antenatal care as well. In this research, it was found that 77.1% of women received antenatal care from medical personnel at least 4 times during pregnancy. However, this was not complemented by a good quality of antenatal care. Many pregnant women in rural areas with moderate and high maternal mortality rate received poor quality of antenatal care.¹¹ Many medical personnel provided antenatal care did not do a good history taking and comprehensive physical examination, resulting in undetected risks of the pregnancy. Medical personnel in a public health center did not do an auscultation,

so a congenital heart disease could not be detected early. Medical personnel usually focus only on obstetric examination. Therefore, ANC can be done at a general practitioner. Apart from public health center, factors that caused maternal death also occurred at satellite hospitals. Some of satellite hospitals are incapable of handling emergency conditions. Some patients with severe preeclampsia were only hospitalized for several days then discharged, resulting in worsening at home. When satellite hospitals are incapable of giving adequate treatment, patients with severe preeclampsia should be referred to tertiary hospital for conservative treatment.

Organizational management played key role in determining quality of care, and ultimately contributed to a large number of deaths.¹² Poor information sharing system is a major contributory factor in this sector, so the hospital staff and the death audit committee's observation highlighted the need for a better team work between midwives, general practitioners, and specialist doctors. One of the example of poor sharing information system was the absence of interdepartmental consultation in some cases that required a joint care, whereas difficult cases treated by doctors from different departments have better outcomes and lower mortality rates compared to difficult cases treated by only one doctor in one department in the hospital.¹³ In some cases, incompleteness of medical records as one of media of information sharing also played a role in maternal death. One pregnant woman with pulmonary tuberculosis (TB) was discharged from satellite hospital without complete diagnosis written on discharge planning, resulting in untreated pulmonary TB and caused death. Another contributing factor from organizational management factor was failure in emergency treatment at satellite hospital, for example a woman with post-partum hemorrhage was referred to secondary hospital, but not optimally stabilized and treated, then referred to Dr. Soetomo General Academic Hospital in unstable condition resulting in death on arrival. A strict hierarchy of referral also contributed to maternal death since it forbid direct referral from primary health center to tertiary hospital, even for special cases

Table 4. Recommendations to address 9 most contributed factors to maternal deaths at Dr. Soetomo General Academic Hospital in 2019.

CONTRIBUTING FACTORS	RECOMMENDATIONS
Families that did not understand about patient's emergency condition (52 cases)	-Increasing education standards for patient and her families. -More frequent health education for pregnant woman and family to reach better understanding that pregnancy always has risks and requires regular check up with medical personnels (midwives/ doctors) -Public health officers are required to socialize the importance of antenatal care for pregnant woman.
Lack of knowledge and skill during antenatal care (42 cases)	-Regular training / workshops about how to provide a good antenatal care involving Obgyn as the trainer.
Delayed antenatal care (20 cases)	-A socialization about the importance of antenatal care for pregnant women by local public health officers, or stakeholders. -A data collection of pregnant women in a residence by local stakeholder, followed by a reminder to go to health care for antenatal care.
Lack of knowledge and skill at the satellite hospital (17 cases)	-Conduct reviews and updates on knowledge and skills training for medical personnels at the hospital on a regular basis.
Poor information sharing system at the satellite hospital (17 cases)	-Increasing teamwork between midwives, general practitioners, and specialist doctors in the hospital to optimize patient care. -Immediate referral to tertiary hospital if there is difficulty in treating the patient at primary or secondary health service.
Failure/delay in emergency treatment at the satellite hospital (13 cases)	-Conduct training for midwives and nurses to provide initial treatment to emergency cases when there is no doctors / specialist on site.
Inadequate treatment at the satellite hospital (11 cases)	-Conduct a morning report with doctors, nurses, and midwives to monitor patient's condition and progress
Poor communication among medical personnel at the satellite hospital (9 cases)	-Provide training for medical personnels on how to communicate effectively with patients, so the patients understand what to do and what to avoid.
Pyramid of referral (7 cases)	-Consider making a simpler referral policy that allows primary health care to refer patients directly to tertiary hospital in specific cases that cannot be managed at secondary hospital.

that could only be managed in tertiary hospital. A pregnant woman with severe pulmonary hypertension from type C hospital was referred to type B hospital before being referred again to Dr. Soetomo General Academic Hospital. Precious and valuable time is usually wasted which results in delays in receiving treatment and leaves the mother in worse condition.

Another factor contributed to maternal death was the availability of blood products and intensive wards. Some satellite hospitals did not have blood banks, and the blood products were collected, managed and supplied by the Indonesian Red Cross that were usually located outside of the hospital building. It was also a problem that some satellite hospital had limited intensive wards that they needed to refer to tertiary hospital for the mother, the baby, or both. There was a case of pregnant woman with gemelli and severe preeclampsia that had to be referred from type B satellite hospital to

Dr. Soetomo General Academic Hospital due to unavailability of NICU, despite the ability of type B hospital to manage gemelli and severe preeclampsia.

In this research, geographic as environment factor seemed to have no contribution to maternal death because road access between cities in East Java are already connected through highways, and pregnant women who did not have private vehicles were facilitated by district ambulance.

Millennium development goals 2015 MMR target was 102 per 100.000 live births. Indonesia's MMR is reported from 272 in 2000 to 177 in 2017.¹⁴ For situations where MMR range between 70 and 240, recommendation focus on improving management of complications, timely referral, and improved application of clinical practice guidelines.¹⁵ Recommendations based on this research in Dr. Soetomo General Academic Hospital are summarized in [table 4](#).

It is important to pay attention to education in our country because there are many contributing factors to maternal death which were related to the level of understanding, knowledge, and skills. For the patient and her family, it is necessary to increase the knowledge about danger signs during pregnancy that must be known. For medical personnel, it is necessary to carry out medical training or workshops to increase knowledge and skills, as well as to improve communication between medical personnel. Hospital referral system should also be improved so the patients do not need to spend a long time in the bureaucracy.

CONCLUSION

The maternal deaths at Dr. Soetomo General Academic Hospital in 2019 were mostly caused by family barrier factor which did not understand about patient's emergency condition, followed by medical personnel factor which was lack

of knowledge and skills during antenatal care. Also, further research with different study designs and larger samples needs to be done to identify the root causes of maternal mortality.

DISCLOSURES

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Conflict of Interest

There is no conflict of interest in this journal publication between authors and any organizations or person that could influence the objectivity during the study, interpreting the result as well as during the writing of the manuscript.

Author Contribution

All Authors involved in concepting, designing and supervising the manuscript and Dimas Ryan Desetyaputra conducted the research. All authors analyzed the data. All authors prepare the manuscript and agree for this final version of manuscript to be submitted to this journal.

Ethical Consideration

This research was approved by the Ethical Committee, Dr. Soetomo General Academic Hospital Surabaya, Universitas Airlangga. Letter of exemption Ref. No. 0284/LOE/301.4.2/I/2021.

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