

## Study of Causes of Neonatal Mortality and its Related Factors in the Neonatal Intensive Care Unit of Imam Reza Hospital in Kermanshah, Iran during (2014-2016)

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### Abstract

#### Background

Neonatal mortality rate is one of the main indicators of health care systems in each country. The first step in improving the level of these indicators is to identify the causes of neonatal death and its related factors. In this study, the causes of neonatal mortality and its related factors in neonatal intensive care unit at Imam Reza hospital were investigated.

#### Materials and Methods

A descriptive cross sectional study was carried out from 2014 to 2016, on all neonates who died in neonatal intensive care unit of Imam Reza Hospital in Kermanshah city, Iran. Information about the infant, mother and the causes of mortality of the infant were collected from hospital records of neonatal care unit and families and physician of infants. Then data was recorded in the data collection form and analyzed using SPSS version 18.0 software.

#### Results

In this study, 566 newborns (19.2%) died of 2,946 hospitalized infants. The most common causes of death was respiratory distress syndrome 190 (33.6%), and sepsis 128 (22.6%); 95.5% of neonatal deaths occurred at gestational age below 37 weeks, and 81.6% in birth weight less than 2,500gr. Also, 452 cases (79.9%) had deaths during the first week after birth, and the highest deaths 274 (48.8%) were in the night shift ( $P < 0.001$ ).

#### Conclusion

According to the results of this study, the most common causes of neonatal death were prematurity (gestational age below 37 weeks), respiratory distress syndrome and sepsis. Most dead neonates have a weight below 2,500 grams. The highest death rate occurred in the first week of birth and in the night shift.

**Key Words:** Neonatal, Prematurity, Respiratory Distress Syndrome, Sepsis.

\*Please cite this article as: Babaei H, Dehghan M, Mohammadi Pirkashani L. Study of Causes of Neonatal Mortality and its Related Factors in the Neonatal Intensive Care Unit of Imam Reza Hospital in Kermanshah during (2014-2016). *Int J Pediatr* 2018; 6(5): 7641-49. DOI: **10.22038/ijp.2017.28212.2441**

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Received date: Aug.25, 2017; Accepted date: Dec.12, 2017

## 1- INTRODUCTION

Neonatal period (birth–28 days) is a highly vulnerable period of life when a neonate may develop certain serious problems which lead to death (1, 2). Accordingly, neonatal mortality rate is considered as a standard indicator for evaluation of health status of a country (3). Neonatal mortality rate is the number of neonates dying before reaching 28 days of age, per 1,000 live births in a given year. Neonatal mortality is highest in the first 24 hours of life and accounts for 65% of infant mortality (4). According to the World Health Organization (WHO) report, worldwide neonatal mortality rates from 36 deaths per 1,000 live births in 1990 decreased to 19 cases per 1,000 live births in 2015, which neonatal mortality rate has fallen by 45 to 47% during these years (5, 6). According to latest statistics released by the United Nations Children's Fund (UNICEF), 2.6 million children died in the first month of life in 2016 – approximately 7,000 newborn deaths every day – most of which occurred in the first week, with about 1 million dying on the first day and close to 1 million dying within the next six days (7, 8).

Iran is one of the countries where the rate of neonatal death is average (4). The neonatal mortality rate in Iran has fallen from 16 per 1,000 live births in 2004 to 9.5 per 1,000 live births in 2015 (9). The causes of neonatal death are generally divided into two categories: biological and non-biological. Although biological factors such as prematurity, infections and asphyxia at birth are known causes of neonatal death, non-biological causes are equally important: including socioeconomic status, gender, literacy of mother and etc (10). According to most of studies carried out in Iran, various factors have contributed to the neonatal mortality, asphyxia at birth, low birth weight ( $\leq 2500$  grams), prematurity (gestational age less than 37 weeks), congenital anomalies,

male sex and also maternal factors such as chronic diseases, diabetes, and preeclampsia are the main risk factors for neonatal deaths (2, 11-14). In the study by Oshvandi et al., the most common causes of neonatal death were respiratory distress syndrome, sepsis, asphyxia, congenital anomalies and disseminated intravascular coagulation (12). In another study conducted by Aramesh et al., the most common causes of death were prematurity, congenital anomalies, prenatal asphyxia and infection (13). In study by Mohagheghi et al., the most common causes of neonatal death were neonatal infections, preterm delivery and low birth weight, among which infections such as sepsis were the most common causes of neonatal death (14).

While in the study by Faraji et al., which was carried out during a period of 5 years from 2006 to 2010, most infants had a birth weight less than 2,500 grams and most of neonatal death occurred during the first 24 hours of birth (15). It seems that this pattern is different in various regions of Iran and even in different hospitals according to maternal and neonatal factors, and if we want to take effective steps to reduce neonatal mortality, the first step is to identify the causes of neonatal mortality; Understanding the causes of death in neonatal intensive care units (NICUs) and the modifiable factors associated with death has the potential to reduce infant mortality. It is necessary to identify the causes of mortality in each country or regions of a country in order to minimize the problems of these plans (16).

Therefore, this study was conducted to determine the causes and predisposing factors of neonatal death in Imam Reza Medical Center of Kermanshah (Iran), a referral center for high risk mothers and infants with 4,000 births on an annual basis and includes at 18 beds NICU.

## 2- MATERIALS AND METHODS

A retrospective descriptive cross sectional study was carried out in the NICU of Imam Reza Hospital in Kermanshah city, Iran, for three years (from 1<sup>st</sup> of January 2014 to 31<sup>st</sup> of December 2016). Information about the infants (the gender, age, weight, gestational age, etc.), and mothers (the age, cause of pregnancy termination, etc.), and the causes of mortality of the infant were collected from hospital records of neonatal care unit. To ensure the accuracy of the information was contacted with the families of infants and their physician. Then data was recorded in the data collection form. Information regarding maternal underlying diseases and health care were extracted from mother's records. Stillborn infants were excluded. We included only infants who died before discharge from the hospital. The qualitative variables were presented as frequency (percent). Chi-square test and, if required, fisher's exact test analysis were employed, as well. The data were analyzed using SPSS, version 18.0 software.

## 3-RESULTS

In this study, out of 2,946 infants admitted to NICU at Imam Reza Hospital in Kermanshah, 566 cases (19.2%) died within 3 years (2014 to 2016). The highest death rate was in 2014 and the lowest was in 2015 as showed in **Table.1**. Results of our study showed that 58.8% of neonatal deaths were boys and 41.3% were girls. Mortality rate in male infants were more than the girls ( $P < 0.05$ ); also, 95.5% of neonatal deaths occurred at gestational age below 37 weeks and 81.6% in birth weight less than 2,500 gr. Regarding birth weights, 25.3% of death their weight  $< 1,000$ g, 29.3% between 1,000-1,500gr, 18.2% between 1500-2000gr. Also, 8.8% between 2,000-2500gr and 18.4% were above 2,500 gr. The route of delivery in 77.2% of the neonates was cesarean

section while, 22.8% delivered by normal vaginal delivery. Chi-square test did not show any significant relationship between birth year and type of delivery ( $p = 0.708$ ). Regarding Mother's age at child birth, 39.9% of the mothers were aged older than 30 years. On the other hand, the results of the study showed that there is a significant difference between the frequency of infant mortality and birth rank of child, and the highest mortality rate was in the first ranked birth ( $p < 0.001$ ). Also, 83.6% of the newborns were not required to be resuscitation in delivery room; while 16.4% of the newborns in need of resuscitation at birth, but, there was no significant relationship between resuscitation in delivery room and birth-year ( $p = 0.763$ ).

In this study, the average score of the first minute Apgar were  $6.04 \pm 2.10$  and the mean of the fifth minute Apgar was  $7.45 \pm 1.98$  as showed in **Table.2**. The main causes of neonatal deaths were respiratory distress syndrome (33.6%), sepsis (22.6%), congenital heart disease (8.3%), and other diagnoses as showed in **Fig.1**. Regarding the presence of maternal risk factors associated with neonatal mortality, there were higher neonatal deaths among neonates born to mothers with preeclampsia (40.3%), the onset of labor pain (18.4%), rupture of membrane (13.3%), amniotic fluid loss (10.2%), and fetal distress (10.2%), respectively as showed in **Fig.2**.

The result of Chi-square test showed that most deaths occurred on days 2 to 7; then, on the first day of birth. Therefore, there was a significant relationship between the mortality rate and the age of the infant ( $p < 0.001$ ). Eleven deaths were infants who were hospitalized at birth, but died at the time of infancy (more than 28 days). These neonates were still hospitalized at the time of death. As it can be seen, there is a significant statistical relationship between the number of infants died and their length

of stay, so that 452 (79.9%) neonates were hospitalized less than one week ( $p < 0.001$ ) as showed in **Fig.3**. The results of the study showed that neonatal mortality was 274 neonates in the night shift, 164 neonates (29%) in the evening shift, and

128 (22.6%) in the morning shift, which was statistically significant ( $P < 0.001$ ). But, the mortality rate was similar in different shifts in different years, and there was no statistically significant difference ( $p = 0.148$ ).

**Table-1:** Frequency distribution (percentage) of neonates dead in three years

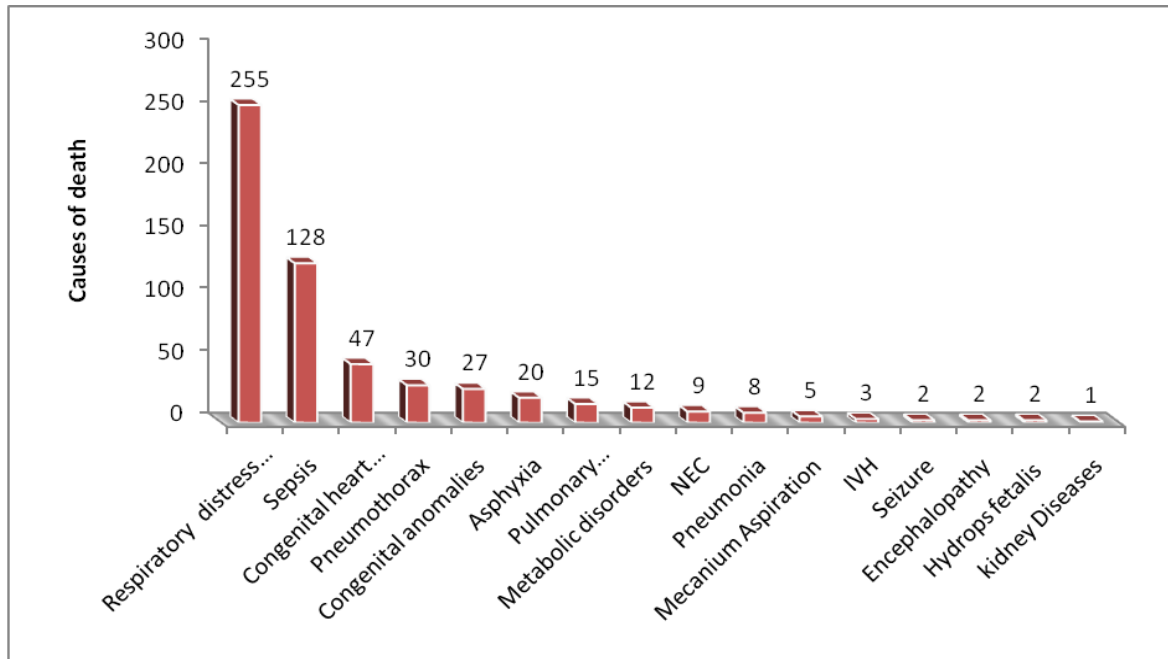
Year	Number of neonates admitted to NICU	Neonates dead Frequency (percent)
2014	956	195 (20.3%)
2015	1012	188 (18.6%)
2016	978	183 (18.7%)

NICU: Neonatal intensive care unit.

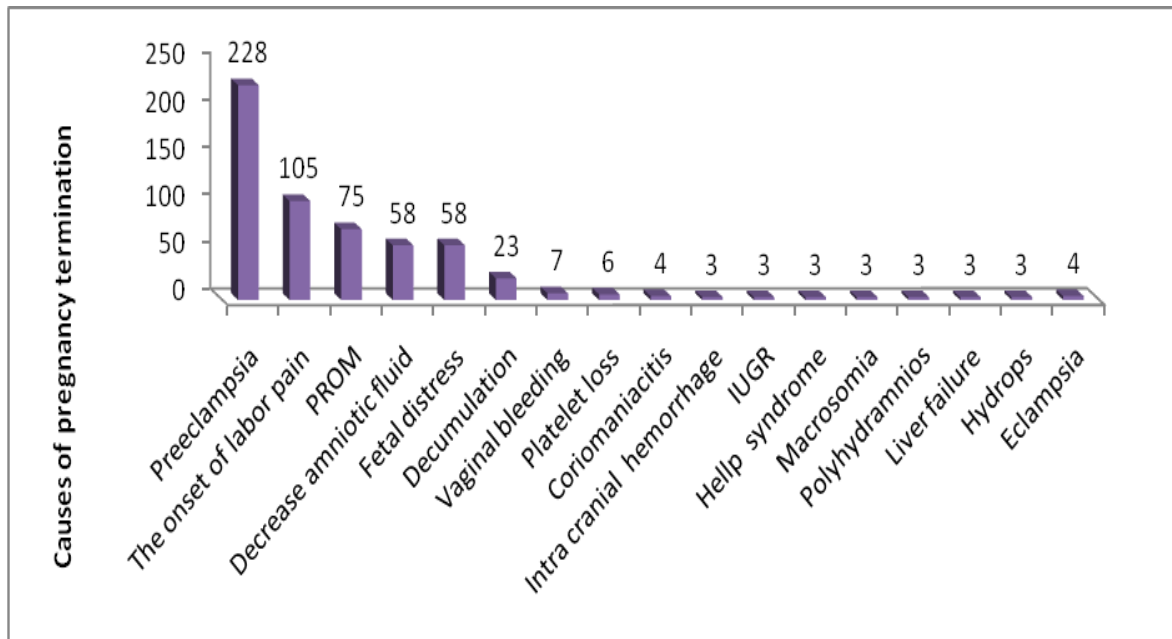
**Table-2:** Frequency distribution of factors affecting the death of newborns

Variables	Number (percent)	P-value
Gender 1. Girl 2. boy	233(41.3%) 333(58.8%)	$p < 0.001$
Birth weight, gr 1. <1000 2. 1000 – 1499 3. 1500 – 1999 4. 2000 – 2499 5. $\geq 2500$	143(25.3%) 166(29.3%) 103(18.2%) 50(8.8%) 104(18.4%)	$p = 0.006$
Gestational age, week 1. < 30 2. 30 – 34 3. 35 – 37 4. > 37	255(45.1%) 189(33.4%) 96(17%) 26(4.6%)	$p < 0.001$
Mode of delivery 1. NVD 2. C.S	129(22.8%) 437(77.2%)	$p < 0.001$
Mother's age, year 1. < 20 2. 20 – 24 3. 25 – 29 4. > 30	36(6.4%) 139(24.6%) 165(29.2%) 226(39.9%)	$p < 0.001$
Birthday rating 1. First Pregnancy 2. Second pregnancy 3. Third pregnancy 4. $\geq$ Fourth pregnancy	260(45.9%) 176(31.1%) 75(13.3%) 55(9.7%)	$p < 0.001$
Resuscitation in delivery room 1. Not Resuscitation 2. Resuscitation	473(83.6%) 93(16.4%)	$p < 0.001$
Apgar 1. First minute 2. Fifth minute	6.04 $\pm$ 2.10(min $\pm$ SD) 7.45 $\pm$ 1.98(min $\pm$ SD)	$p < 0.001$

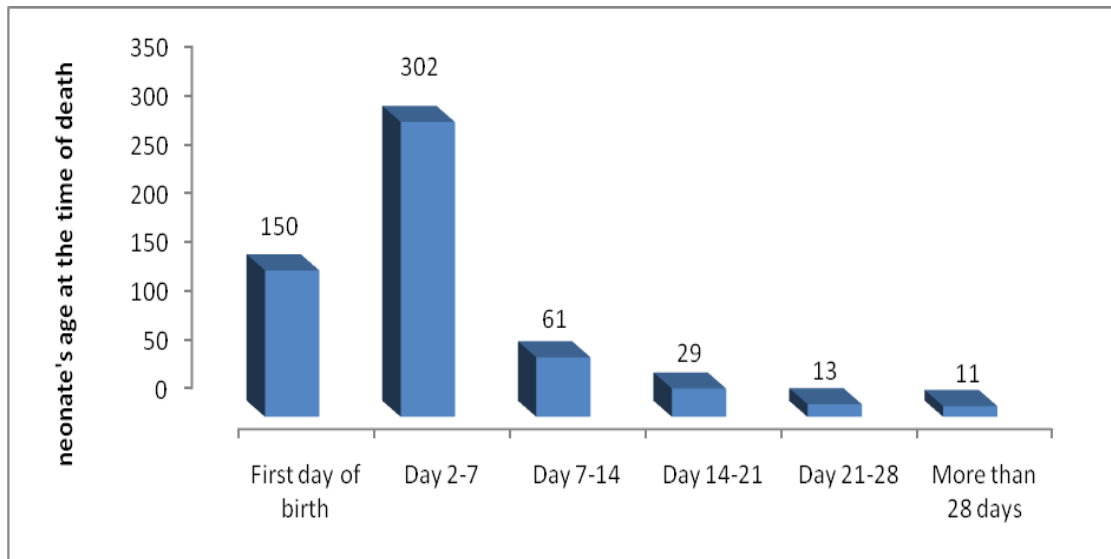
SD: Standard deviation; NVD: normal vaginal method; C.S: Cesarean section.



**Fig.1:** Frequency distribution (percentage) of neonates dead according cause death within three years (2014-2016). NEC: Necrotizing enterocolitis; IVH: Intraventricular hemorrhage.



**Fig.2:** The frequency distribution (percentage) of neonates dead according cause of pregnancy termination within three years (2014-2016). PROM: Premature rupture of membranes; IUGR: Intrauterine growth restriction.



**Fig.3:** The frequency distribution (percentage) of neonates dead according neonate's age at the time of death within three years (2014-2016).

#### 4- DISCUSSION

Since the study of causes of death is the first step in reducing it, the present study was carried out. Such studies have been done in other parts of the country and the world and should be continually continued; because different countries, as well as over the years, may have different results. According to the results of this study, the mortality rate of neonates was 19.2%, which is higher than the average statistics of Iran and the world. This is because the center is the birth referral center of the province and the birth rate of the premature infants is high. In this study, the most common causes of death in all newborns were respiratory distress syndrome (33.6%), sepsis (22.6%), and congenital heart disease (8.3%). In the study of Oshvandi et al., the most common causes of neonatal mortality were respiratory distress syndrome and sepsis respectively (12). Also, in another study in Ahwaz, the most common causes of neonatal death were respiratory distress, septicemia, asphyxia, and intracranial hemorrhage (17) which is consistent with the present study. But in a study conducted in Ardabil, the mortality rate from sepsis was 2.5 to 9.14% in comparison to the year

studied and the years before the study. In this study, death from sepsis complications was also considered as a sepsis infection (18). The results of the study indicated that 302 neonates (53.4%) died on days 2 to 7 after birth and 150 neonates (26.5%) died on the first day, which complied with the studies (19, 20). It seems that the causes of death in the first week due to the prevalence of death due to respiratory distress syndrome are justified, because most deaths occur in these patients during the first week, especially after the third day. Also, in the present study, 54.6% of neonates weighed less than 1,500 grams. A study was performed by Bijary et al., indicated that 46.4% of dead infants had less than 1,500 gr weight (19). Another study, conducted in Ardabil between 2006 to 2007 years, 75% of expired infants were low birth weight (20) which is in agreement with the present study. Due to the high prevalence of low birth weight (LBW) infants and severe prematurity, most babies born with less than 1,500gr, and in particular less than 1,000gr, and their need for intensive care, can be justified by mortality rates. Therefore, prevention of preterm labor is an important factor in reducing infant mortality. The results of the study showed that 255

neonates (45.1%) had gestational age less than 30 weeks, 189 neonates (33.4%) had gestational age of 34-30 weeks. In a study conducted in al-Zahra Rasht Hospital in 2006 to 2010, (13.4%) infants was gestational age less than 26 weeks, and (49.1%) had gestational age of 26-32 (14). Also, in the study by Boskabadi et al., in Ghaem Hospital Mashhad, 85% of the infants died were premature infants (21). Another study that was conducted in Qazvin in 2010, 60% of died infants had gestational age 34-20 weeks, 10% in 35-36 weeks, and 30% gestational age greater than 37 weeks (22). All of these studies are in line with the current study. Considering the high prevalence of death in newborns with less gestational age, more care during pregnancy, promotion of maternal health and the implementation of educational intervention programs for high risk groups for the prevention of preterm labor as the most important cause of neonatal mortality are of particular importance and effective of reduces neonatal mortality rate.

In this study, 274 neonates (48.4%) died at night shift, which is consistent with Falahi et al. (23). Considering the increased death of infants during the night and the need for special care, increasing the number of nurses in nursing can be effective in reducing neonatal mortality. The present study showed that 333 (58.8%) infant dead were boys and 233 (23.2%) infant dead were girls. In a study conducted in Golestan during 2011-2013, 69.2% of the infants died were boys (24). Also, in another study conducted at Sultan Qaboos Hospital in Amman (2009 to 2006), the number of boys (59%), and girls (41%) were reported which the study of the two studies was in line with our results (25). But in the study of Nayeri et al. in Valiasr Hospital in Tehran, 49.5% of died infants were boys and (46.7%) were girls which there was no significant difference in mortality rate in the boy and girl neonates and their results differ with the present

study (26). Given the fact that boy infants are more likely to have a higher birth weight than girl infants, increase of mortality rates in boys' newborns are justifiable. The results of this study showed that 437 (77.2%) of the infants delivered by cesarean section and 129 (22.8%) were the result of normal delivery, which was coordinated with a study conducted at Shohada Tajrish Hospital (23), and a study conducted in Ardabil (20) and Al-Amara city, Iraq (27). The cause of higher cesarean section rates can be due to complications during pregnancy and the need for termination of pregnancy and this shows the importance of normal delivery and favorable effects and avoiding unnecessary cesarean section. In this study, the average score of the first minute APGAR were 6.04 and the mean of the fifth minute APGAR was 7.45.

In the study of Nayeri et al., in Valiasr Hospital in Tehran, the average score for the first minute APGAR was 5.23 and the mean fifth minute APGAR score was 7.23 (26), which is relative to our study. The result of this study showed that 45.9% of the neonates were the result of the first pregnancy and 31.1% of the second pregnancy. In a study conducted in Shohada Tajriysh Hospital in Tehran (65%) of the neonates were the result of the third and lower pregnancy, and (35%) were the result of fourth or more pregnancy (23) and the result obtained in our study was more than these researches. In this study, 93 neonates (16.4%) were resuscitated in the delivery room and 473 neonates (83.6%) were not resuscitated in the delivery room. In study of Bijar et al., (30.7%) of neonates were resuscitated in the delivery room (19). Therefore, the number of neonates resuscitated at the time of birth in present study is less than study of Bijar et al. In this study, the most common cause of termination of pregnancy and preterm delivery was preeclampsia (40.3%). Therefore, the

control of blood pressure in pregnant women and their examination in terms of preeclampsia is important in reducing the preterm infant birth and infant mortality.

#### **4-1. Limitations of the study**

In this study the data collection, it was reflect percentage of our hospital, and not all cities in our country. The children including in our study composed about all cases attend to hospital. We need more information and studies for covering such subjects. We recommend better care of preterm babies, especially those with respiratory distress syndrome (RDS), and steps to prevent or decrease RDS, birth asphyxia and congenital anomalies. By increase orientation, improve the antenatal care services and offer advanced planning strategies to improve neonatal outcome.

#### **5- CONCLUSION**

According to the results of this study, the most common causes of neonatal death were prematurity (gestational age below 37 weeks), and its related complications for example respiratory distress syndrome and sepsis. Most dead neonates have a weight below 2,500 grams and the result of caesarean section. The highest death rate occurred in the first week of birth and in the night shift. Also, the more number of infant dead were boys and less number of infants dead was resuscitated in the delivery room. Considering the high prevalence of neonatal mortality with lower gestational age, more care in preventing preterm delivery as the most important cause of neonatal mortality can be of particular importance in reducing neonatal mortality. So, prevention of preterm labor and its complications are important factors in reduce neonatal mortality. Of course, other measures such as more nursing care, especially in night shifts, and more emphasis on vaginal delivery are one of the most important factors that can reduce neonatal mortality rate.

**6- CONFLICT OF INTEREST:** None.

#### **7-ACKNOWLEDGMENTS**

The authors would like to thank the administrators of Imam Reza Hospital in Kermanshah. We also thank Ms. Mojgan Rouhani and Shokoufe Javid, who helped us with this research.

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