

Neonatal Audit in Prof. Dr. I Goesti Ngoerah Gde Ngoerah Hospital in Two Years

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Abstract: *Introduction:* The first month of life is the most vulnerable period for child survival, with 2.4 million newborns dying in 2020. Neonatal audit is important to support quality improvement in neonatal unit. This study is to comprehend factors that influence neonatal morbidity and mortality in neonatology unit Prof. Dr. I Goesti Ngoerah Gde Ngoerah Hospital in year of 2020 and 2021. *Material and Methods:* This study was descriptive cross sectional study, the sample were all neonates treated in neonatology unit and registered by medical record in neonatology unit. *Results:* This study involved 2270 neonates in both years. Neonates who were born in Prof. Dr. I Goesti Ngoerah Gde Ngoerah Hospital was decreased 13.4% in 2021 and cesarean section was the highest mode of delivery in both year (59.3% and 65.9%). The majority of gestational age was more than 37 weeks (53.1% and 60.6%) and also the majority of birth weight was more than 2500 gram (59.7% and 54.3%). There also had increasing case of sepsis with 9.3% in 2021. There was no significantly difference of surfactant exogen administration in both year (1.3% and 1.2%). Neonates with Retinopathy of prematurity (ROP) and mother used steroid in pregnancy was decreased 0.9% in 2021. Respiratory distress syndrome was increased 4.9% in 2021. Cardiac and blood vessel anomaly was the highest cause of congenital anomaly in both years (35.5% and 38.5%). Neonates who use ventilator support increased 9.7% in 2021 with duration of ventilator usage less than 7 days. There was decreased 0.7% neonatal death in 2021. The most common cause of mortality was sepsis (77.3% and 61.5%), respectively. Neonates who were born less than 28 weeks and birth weight less than 1000 gram were the highest case of mortality in both year. *Conclusion:* The neonatal audit is important to do to know more precise data about the situation among neonatal care in the hospital. Some strategies were needed to reduce neonatal mortality such as decreasing premature and low birth weight deliveries and prevention of neonatal sepsis.

Keywords: Neonatal, Audit, Hospital

1. Introduction

The first month of life is the most vulnerable for infant survival, with 2.4 million babies expected to die in 2020. According to data from the World Health Organization (WHO), 2.4 million newborn deaths occur annually in Southeast Asia, with neonatal mortality averaging 39 per 1000 live births. The United Nations (UN) announced the Sustainable Development Goals (SDGs) as a continuation of the Millennium Development Goals (MDGs), with Indonesia

and 193 other nations participating. One of the goals specified in this agreement is to minimize newborn mortality not more than 12 deaths per 1,000 live births. In 2020, the infant mortality rate in Indonesia was 11.7 per 1000 births. The leading causes of newborn mortality in Bali in 2015 were preterm, hypoxia, sepsis, birth trauma, low birth weight, respiratory diseases, and congenital anomalies [1, 2].

World Health Organization (WHO) has created a guide by using neonatal audit as a systematic analyses to understanding factors leading to morbidity and mortality in neonates. In its 2016 Audit Guide, the World Health Organization (WHO)

identifies three important goals of auditing neonatal deaths: to understand the burden of neonatal deaths, to generate information about causes of death and modifiable factors, and to provide accountability for results and full decision-making [3]. National Neonatal Audit is a program administered in the United Kingdom by the Royal College of Pediatrics and Child Health. Each year, the program (NNAP) is administered by the Ministry of Health to assist professional service providers, families, and other agencies in enhancing the delivery of neonatal health care. The objective of the neonatal audit was to evaluate the services given to neonates by each institution and to identify the quality enhancements made [4, 5].

There are insufficient statistics about the implementation of neonatal audits in Bali. In Prof. Dr. I Goesti Ngoerah Gde Ngoerah Hospital, the numbers of neonatal mortality and some factors associated with neonatal mortality and morbidity was never reported. The purpose of this study was to establish the profile of morbidity and mortality among neonatology unit at Prof. Dr. I Goesti Ngoerah Gde Ngoerah Hospital in 2020 and 2021.

2. Material and Methods

The Neonatology unit of Prof. Dr. I Goesti Ngoerah Gde Ngoerah Hospital was the setting for this descriptive cross-sectional study, which was carried out in 2020 and 2021. In the years 2020 and 2021, information was gathered from the newborn admission and death registry. All newborns who received care in the neonatology ward at Prof. Dr. I Goesti Ngoerah Gde Ngoerah Hospital met the inclusion criteria. Subjects with an incomplete medical history were excluded.

Total purposive sample was used during the sampling process. The percentage formula was used to determine the sample size, and the minimum necessary sample size was 865 neonates. The SPSS program was used to analyze all data, which was then presented in narrative and tabular style. Percentages were used to show categorical data. This study was approved by Research Ethics Committee of The Faculty of Medicine at Udayana University/Sanglah General Hospital Denpasar No. 1005/UN14.2.2.VII.14/LT/2022.

The operational definitions of the variables in this study were as follow:

1. The temperature on admission was defined body temperature that measured after birth or resuscitation if the baby was born in Sanglah hospital. The temperature on referred was defined body temperature measured when baby arrived in emergency room Sanglah hospital. That is classified into 3, namely: hypothermia: the axillary temperature on admission was $<36.5^{\circ}\text{C}$, normothermia: the axillary temperature on admission was $36.5^{\circ}\text{C} - 37.5^{\circ}\text{C}$, hyperthermia: the axillary temperature on admission was $>37.5^{\circ}\text{C}$.
2. The delivery mode was defined as a mechanism of labor, grouped into the cesarean section, normal labor, forceps delivery, and vacuum extraction.
3. The neonatal mortality rate was defined as the number of neonatal deaths per 1000 live births, stated

in nominal data.

4. Surfactant exogen administration was defined as surfactant administration to preterm neonates in reducing respiratory distress.
5. Respiratory distress syndrome was defined as preterm newborn with the symptoms of breathing difficulty (tachypnea, grunting, intercostal retractions), that appear soon after birth. RDS was confirmed by a typical radiological pattern with reduced air content and reticulogranular pattern of lung and air bronchograms.
6. Steroid administration was defined as steroid administration for pregnant women at risk of preterm delivery from 24 weeks to 34 weeks of gestation age.
7. Days of mechanical ventilation was defined as duration of newborn requiring invasive mechanical ventilation during hospitalization, was grouped into 4, namely: <7 days, 7-14 days, 14-21 days, >21 days.
8. Sepsis was defined as clinical syndrome in the form of at least 1 clinical symptom such as letargis, rapid breathing, temperature instability that arises due to systemic inflammatory response or minimum 2 indicators of infection markers that occurs due to infection.
9. Early onset sepsis was defined as sepsis within the first 72 hours of life.
10. Late-onset sepsis was defined as sepsis after 72 hours of life.
11. Gestational age was defined was calculated from the first day of mother's last menstruation until the baby was born or from the result of ultrasound examination, grouped into: <28 weeks, $28 - <32$ weeks, $32 - <37$ weeks, ≥ 37 weeks.
12. Birth weight was defined as the body weight of a baby at the first hour of birth, grouped into: <1000 grams, 1000-1499 grams, 1500-2499 grams, and >2500 grams.
13. The congenital anomaly was defined as structural abnormalities acquired from birth.
14. Retinopathy of prematurity was defined as a disease that affects immature vasculature in the eyes of premature newborn.

3. Results

We found 2320 neonates treated in Neonatology unit ward Prof. Dr. I Goesti Ngoerah Gde Ngoerah Hospital during the study period in the year of 2020 and 2021. Fifty neonates were excluded from this study because of uncompleted data. Thus, a total of 2270 neonates were included in our samples, with 1154 of them receiving care in 2020 and 1116 in 2021. This study found that neonates who were born in Prof. Dr. I Goesti Ngoerah Gde Ngoerah Hospital decreased from 77.9% in 2020 to 64.5% in 2021, but the referred neonates increased from 22.1% in 2020 to 35.5% in 2021.

The number of cesarean section was increased 6.6% in 2021, neonates who were born per vaginal was decreased 5.2% in 2021, forceps and vacuum was not significantly different in both years. Majority of the subjects were born with normal

birth weight (59.7% and 54.3%) and aterm neonates in both years (53.1% and 60.6%). Complete data of this study can be seen in table 1.

Based on clinical characteristics, it was found that in 2020 there were 11 (0.9%) neonates with hypothermia whereas in 2021 there were 25 (2.3%) neonates with hypothermia. Majority of them have a normal temperature (98.8% and 97%), respectively. In 2020, there were 305 neonates diagnosed with sepsis, among them 291 (95.4%) in the early onset sepsis and 14 (4.6%) in the late-onset sepsis, whereas in 2021, there were 399 neonates diagnosed with sepsis with 375 (93.4%) classified as early-onset sepsis and 24 (6%) in the late-onset sepsis.

There was no significantly difference of surfactant exogen usage in both year 16 (1.3%) neonates and 15 (1.2%) neonates. Neonates with Retinopathy of Prematurity (ROP) was decreased from 38 (3.3%) in 2020 to 27 (2.4%) in 2021 and mother who used steroid during pregnancy was decreased with 7.3% in 2020 and 6.4% in 2021. The proportion of newborn with respiratory distress was increased 4.9% in 2021. Cardiac and blood vessel anomaly was the highest cause of congenital anomaly in both years (35.5% and 38.5%). Complete data can be seen in table 2.

Table 1. Characteristics of samples.

Characteristic	2020 (n=1154)	2021 (n=1116)
Place of Delivery, n (%)		
- Prof Dr. I Goesti Ngoerah Gde Ngoerah Hospital	899 (77.9)	720 (64.5)
- Other hospital	255 (22.1)	396 (35.5)
Mode of delivery, n (%)		
- Caesarian section	684 (59.3)	735 (65.9)
- Vaginam	441 (38.2)	369 (33)
- Forceps	16 (1.4)	4 (0.4)
- Vacuum	13 (1.1)	8 (0.7)
Gestional age, n (%)		
< 28 weeks	44 (3.8)	49 (4.4)
28 – <32 weeks	142 (12.3)	122 (10.9)
32 – <37 weeks	356 (30.8)	269 (24.1)
≥37 weeks	612 (53.1)	676 (60.6)
Birth weight, n (%)		
<1000	53 (4.6)	66 (5.9)
1000-1499	82 (7.1)	111 (10)
1500-2499	330 (28.6)	333 (29.8)
>2500	689 (59.7)	606 (54.3)

Table 2. Characteristics of neonatal morbidity.

Characteristic	2020 (n=1154)	2021 (n= 1116)
Temperature on admission, n (%)		
Hypothermia	11 (0.95)	25 (2.3)
Normothermia	1140 (98.8)	1078 (97)
Hyperthermia	3 (0.26)	13 (1.1)
Sepsis, n (%)	305 (26.4)	399 (35.7)
Early onset sepsis	291 (95.4)	375 (93.4)
Late onset sepsis	14 (4.6)	24 (6)
Surfactant exogen, n (%)	16 (1.3)	15 (1.2)
ROP, n (%)	38 (3.3)	27 (2.4)
Steroid administration, n (%)	84 (7.3)	71 (6.4)
Respiratory Distress Syndrome, n (%)	51 (4.4)	104 (9.3)
Congenital Anomaly, n (%)	113 (9.8)	122 (10.9)
Brain and nerve anomaly	7 (6.2)	14 (11.5)

Characteristic	2020 (n=1154)	2021 (n= 1116)
Cardiac and blood vessel anomaly	40 (35.5)	47 (38.5)
Respiratory organ anomaly	5 (4.4)	3 (2.5)
Gastrointestinal anomaly	37 (32.7)	31 (25.4)
Kidney and excretion organ anomaly	9 (7.9)	15 (12.3)
Musculoskeletal anomaly	0 (0)	4 (3.3)
Others	15 (13.3)	8 (6.5)

According to table 3, mechanical ventilation usage were 298 neonates in 2020 and 491 neonates in 2021. The percentage of continuous positive airway pressure (CPAP) usage was decreased 10,7% in 2021 (43.7% to 33%) whereas ventilator support usage was increased 10,7% in 2021 (56.3% to 67%) with most of them use conventional mechanical devices (46.3% and 50%) and duration of ventilator usage less than 7 days was increased 43.6% in 2021 (52.4% to 96%), respectively. Complete data can be seen in table 3.

Table 3. Characteristics of mechanical ventilation.

Characteristic	2020 (n=298)	2021 (n=491)
Mechanical ventilation, n (%)		
CPAP	130 (43.7)	167 (33)
Ventilator	168 (56.3)	324 (67)
HFO	30 (10)	81 (17)
Conventional mechanical ventilation devices	138 (46.3)	243 (50)
Duration of ventilator, n (%)		
<7 days	88 (52.4)	310 (96)
7-14 days	46 (27.4)	9 (2.7)
14-21 days	19 (11.3)	4 (1.2)
>21 days	15 (0.9)	1 (0.3)

Total 106 neonates died in 2020 whereas 96 neonates died in 2021, so that neonatal mortality rate was decreased 0.7% in 2021. The most common cause of death among them were sepsis with 82 (77.3%) in 2020 and 59 (61.5%) in 2021. Neonates who died with gestational age less than 28 weeks was 15 (51.7%) in 2020 and 13 (36.1%) in 2021. Neonates who died with birth weight less than 1000 gram was decreased in 2021 (65.6% and 40.4%), respectively. Complete data can be seen in table 4.

Table 4. Characteristics of neonatal mortality.

Characteristic	2020 (n=106)	2021 (n=96)
Mortality, n (%)	106 (10.1)	96 (9.4)
Cause of death, n (%)		
Septic shock	82 (77.3)	59 (61.5)
Prematurity	5 (4.7)	2 (2.1)
Respiratory disorder	7 (6.6)	25 (26)
Cardiology disorder	3 (2.8)	3 (3.2)
Metabolic disorder	1 (1)	1 (0.9)
Congenital anomaly	8 (7.6)	6 (6.3)
Gestational Age, n (%)		
< 28 weeks	15 (51.7)	13 (36.1)
28 – <32 weeks	14 (10.9)	31 (34.1)
32 – <37 weeks	32 (9.9)	22 (8.9)
≥37 weeks	45 (7.9)	30 (4.6)
Birth weight, n (%)		
<1000	21 (65.6)	19 (40.4)
1000-1499	17 (26.1)	23 (26.1)
1500-2499	34 (11.5)	22 (7.1)
>2500	34 (5.2)	32 (8.5)

4. Discussion

In Indonesia, the number of newborn deaths recorded by the government was lower than the real number due to a lack of hospital reporting and auditing to the government. Every hospital must do the newborn audit for this reason. By knowing the actual number of mortality, the awareness will increase, and strategy can be planned to avoid further neonatal mortality [1, 3, 4].

In this study, neonates who was born in Prof. Dr. I Goesti Ngoerah Gde Ngoerah Hospital was 899 (77.9%) neonates in 2020 and 720 (64.5%) neonates in 2021 while the others referred from other hospitals with 255 (22.1%) neonates in 2020 and 396 (35.5%) neonates in 2021 that need to be intervened for better facilities. High risk of neonates especially with expected low birth weight and gestational age should be delivered in higher healthcare facilities that had a hospital team with the NICU experience and resources to provide better outcome of life [4]. Certain medical grounds necessitate the performance of a cesarean section due to the possibility of maternal mortality during pregnancy and delivery. In this study, a cesarean section was the most common method of birth in both years (59.3% and 65.9%, respectively). In Prof. Dr. I Goesti Ngoerah Gde Ngoerah Hospital, there were a large number of caesarean deliveries due to the hospital's role as a referral facility for high-risk mothers and infants, and the availability of adequate facilities and resources compared to other hospital. Research in Indonesia (2020) found that the proportion of cesarean deliveries was 19.08% and factors that influenced increase in cesarean section delivery was the mothers perceptions of cesarean delivery as being safer than vaginal delivery and also because certain medical indications [6].

In this study, we discovered that preterm births decreased by 7.5% in 2021. According to the World Health Organization, there were around 18 preterm births per 1000 live births in Indonesia. Prof. Dr. I Goesti Ngoerah Gde Ngoerah Hospital (2019) discovered that the majority of neonates treated in the NICU were preterm, male, and of low birth weight (< 2500 grams) [2-7]. Preterm birth is associated with neurodevelopmental problems, pulmonary dysfunction, visual impairment, and sensorineural hearing loss in the future, according to research conducted at a hospital in Vietnam. Preterm birth is also associated with long-term neurodevelopmental problems, pulmonary dysfunction, visual impairment, and sensorineural hearing loss [8].

This study revealed that the majority of newborns are admitted with normal body temperature (94.4% vs. 97.7%). Low temperature has been associated to an increased risk of morbidity and death in premature newborns, according to the National Neonatal Audit Programme in 2020. Nonetheless, there is need for improvement in the promotion of normothermia upon admission to a newborn hospital, particularly for preterm neonates [3, 4].

Sepsis is a dysregulated host response to infection that results in organ failure that threatens life. In this study, the prevalence of sepsis increased by 9.3 percent by 2021. Early

onset newborn sepsis (EOS) as a cause of sepsis in both years (95.4 and 93.4%, respectively). According to a 2016 Global Burden of Disease (GBD) study, there were approximately 1,3 million instances of neonatal sepsis per year. Newborn sepsis incidence in the whole time was 2,824 cases per 100,000 live births. Early onset neonatal sepsis cases had a higher estimated incidence and death than late onset neonatal sepsis cases [1-4].

Babies born prematurely or with a very low birth weight are at risk for prematurity retinopathy (ROP). In this study, the ROP percentage declined by 0.5% in 2021. Retinopathy of prematurity (ROP) is a condition that impairs the development of the blood vessels in the retina and is caused by prolonged exposure to a high oxygen concentration, sepsis, transfusion, and infection. A low incidence of retinopathy of prematurity (ROP) is one of the positive indicators of newborn care, and this is often averted by "timely" screening. Research conducted in South Korea over a 12-year period using a population-based database revealed a decline in the incidence of ROP among premature infants; the incidence was 0.97 times lower in males than in females and 4.29 times higher in the gestational age group of 28 than in the gestational age group of 28-37 [6].

Hyaline membrane disease is one of the commonest health problem encounter in preterm neonates, typically worsen within the first 48 to 72 hours and it also as one of the significant predictor of neonatal morbidity and mortality. In this study, the incidence of HMD was increased 4.9% in 2021 (4.4% and 9.3%), respectively. According to a study done in Ethiopia, the incidence of hyaline membrane disease was 40.0%, and 49.5% of those were died. About three-quarters of preterm neonates could survive if they had access to early screening and care, such as surfactant replacement therapy and corticosteroid administration for the mother, to prevent bronchopulmonary dysplasia (BPD) or 'chronic lung disease' caused by long-term ventilator use [7].

The clinical features of surfactant not significantly difference for surfactant usage in both year (1.3% and 1.2%). Treatment with surfactant should be administered to infants with or at high risk for respiratory distress syndrome. Newborns with less than 26 weeks gestational age and infants requiring intubation in the delivery room should get prophylaxis. Within 12 to 24 hours of administration, the use of exogenous surfactant can considerably enhance PCO₂, PH, FiO₂, modified ventilator, and respiratory severity score (p < 0,05) [8, 9].

Antenatal corticosteroids have been shown to reduce morbidity in preterm infants. In this research, corticosteroid use declined by 0.9% from 7.3% to 6.45% in 2021. Antenatal steroids are a potent health intervention administered by obstetricians and midwives before to the delivery of a preterm infant to lower the risk of respiratory distress syndrome and other significant consequences such as bleeding into the brain [9]. Three hundred fifty-six (35.3%) mothers and 385 (34.2%) neonates were received at least one dosage of steroid between 24 and 34 weeks of gestation, according to a research done in a hospital in Tanzania. Those newborns who were exposed to

steroids had a reduced risk of perinatal death than those who were not [10].

In Prof. Dr. I Goesti Ngoerah Gde Ngoerah Hospital, mechanical breathing device are continuous positive airway pressure (CPAP) and ventilators are used mechanically (HFO and conventional mechanical ventilation device). In 2021, the usage of CPAP decreased 10.6%, while the use of ventilators increased 10.7%. Mechanical ventilation use to allow proper gas exchange and reduce the newborn's work of breathing to lowering the risk of lung damage. In Indian study, respiratory distress syndrome, sepsis, birth asphyxia, meconium aspiration syndrome, meningitis, and pneumonia were indications for ventilator usage [11]. In contrast to a study from Iran (2011), our findings indicated that CPAP assistance was beneficial in treating newborns with respiratory distress and shortened their hospital stays [12].

Respiratory assistance with mechanical ventilation is necessary for the survival of a significant number of extremely premature neonates. However, continuous mechanical ventilation is associated to several problems that result in a variety of morbidities in premature neonates. In our analysis, the duration of ventilator use was less than 7 days (83% and 96%), respectively. A cohort research in Korea revealed that babies who got mechanical ventilation for more than two weeks had a considerably higher death rate than those who had mechanical ventilation for seven days or less. Exposure to mechanical ventilation for more than 2 weeks was related with retinopathy of prematurity, periventricular leukomalacia, and bronchopulmonary dysplasia (BPD) [13].

In this study, we found cardiac and blood vessel anomalies was the highest percentage of congenital anomalies in both year (35.5% and 38.5%), respectively. In Bali, Prof. Dr. I Goesti Ngoerah Gde Ngoerah Hospital developing Sanglah Birth Defect Integrated Center (SIDIC) programme to be able to perform fetal intervention for infants with congenital anomalies from national to international level. Study conducted in Prof. Dr. I Goesti Ngoerah Gde Ngoerah Hospital found 65 types of congenital anomaly in 1 year, most system affected in the newborn were gastrointestinal system 16 (24.5%) neonates, central nervous system 15 (23%) neonates, multisystem anomalies 13 (20%) neonates, musculoskeletal system 4 (6.1%) neonates, cardiovascular system 8 (12.3%) neonates, miscellaneous 8 (12.3%) neonates and genitourinary system 1 (1.5%) neonates [14]. In this study, there was decreased of mortality rate in the past 2 years (10.1% to 9.4%) with the cause of death majority by sepsis (77.3% and 61.5%). Neonates who were born less than 28 weeks and who were born less than 1000 gram are the highest percentage of mortality in both years. Sepsis is still the leading cause of death in both year (77,3% and 61,5%) [15, 16]. Neonatal mortality rate for Indonesia was 11.7 deaths per 1,000 live births in 2020. Previous study by Junara *et al* in 2012 found that sepsis was the highest cause of death amount to 30.4% and associated with low birth weight and prematurity [17, 18]. Study conducted in Prof. Dr. I Goesti Ngoerah Gde Ngoerah Hospital (2020) mentioned the mortality rate was 28.2% in NICU and found that 393 patients died with sepsis

(67.57%). In Indonesia, low birth weight neonates (<2500 grams) was 5.5 times for neonatal deaths (95% CI: 3.59 – 8.57, $p = 0.00$). Differences in mortality rate in every country can be explained by various factors such as economical, geographical factors, social factors, respiratory devices usage, incubators and microorganisms [19, 20].

Low birth weight and preterm are two of the numerous risk factors that might impact neonatal sepsis. This research gives an opportunity to evaluate the care and outcomes in our unit, and the resulting data will be beneficial for studying infant morbidity and death and enhancing neonatal care generally. We did not evaluate the association between profiles and outcomes, therefore we were unable to identify the the predictor factors. In addition, we were unable to determining the factors influencing morbidity, such as the duration of NICU and hospital stays.

5. Conclusion

The neonatal audit is important to do to know more precise data about the situation among neonates in the hospital. This study involved 2270 neonates treated in perinatology ward from in the year of 2020 and 2021 with mode of delivery by cesarean section and were dominated by aterm neonates with birth weight >2500 gram. There was no significantly difference of surfactant exogen administration and mother used steroid in pregnancy was decreased 0.9%. Respiratory distress syndrome was increased 4.9%. Cardiac and blood vessel anomaly was the highest cause of congenital anomaly. Neonates who use ventilator support increased 9.7% with duration of ventilator usage less than 7 days. Total 202 neonates died in two years and neonatal mortality was decreased 0.7% in 2021. Sepsis was the leading cause of mortality, with neonates born less than 28 weeks and birth less than 1000 grams were the highest case of mortality. Further research should be done with a larger number of subject and carried out to find the risk factor influencing morbidity and mortality in neonates.

Declarations

This study has been undergone the ethical clearances from center of research study (LITBANG) of Udayana University and has already gotten a legal permit from Sanglah Central Hospital in order to access medical record data.

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