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In partial fulfillment of the requirements for the degree of

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PAEDIATRICS

"A STUDY OF CLINICAL RISK INDEX OF BABIES II (CRIB II) AND SCORE FOR NEONATAL ACUTE PHYSIOLOGY II (SNAP-PE II) TO IDENTIFY CLINICAL PARAMETERS ASSOCIATED WITH POOR OUTCOMES IN REFERRED NEONATES"

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I hereby declare that this dissertation entitled **"A STUDY OF CLINICAL RISK INDEX OF BABIES II (CRIB II) AND SCORE FOR NEONATAL ACUTE PHYSIOLOGY II(SNAP-PE II) TO IDENTIFY CLINICAL PARAMETERS ASSOCIATED WITH POOR OUTCOMES IN REFERRED NEONATES"** is a bonafide and genuine research work carried out by me under the guidance of **Dr. K.N.V PRASAD**, Professor, department of PAEDIATRICS, Sri Devaraj Urs Medical College, Kolar in partial fulfillment of University regulation for the award "**DOCTOR OF MEDICINE IN PAEDIATRICS**", the examination to be held in May 2020 by SDUAHER. This has not been submitted by me previously for the award of any degree or diploma from the university or any other university.

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is a bonafide research work done by **Dr. S K MOHAMMED YASAR,** under my direct guidance and supervision at Sri Devaraj Urs Medical College, Kolar in partial fulfillment of the requirement for the degree of "**M.D. IN PAEDIATRICS"**.

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ABSTRACT

Background: Neonatal mortality has continued to be a serious issue across the world Prematurity and sepsis are the two major causes of mortality and morbidity among the neonates. Various scoring systems such as CRIB II and SNAPEE II have assisted in predicting the mortality and morbidity among new born irrespective of gestational age and weight. There is lack of literature regarding the issues with transport, referral in particular with neonatal health care ; absence of guidelines for stabilizing of neonates before referral, relatively few studies neonatal severity of illness scores in referred neonates which account for morbidity and mortality in neonates. The present study aimed to use CRIB and SNAP-PE II score on all referred neonates to identify parameters with increased risk of mortality and morbidity in referred neonates.

Materials and methods: The study was a prospective observational study involving 70 neonates. CRIB and SNAP-PE II score was applied at the time of admission to NICU and individual scores were obtained. Each neonate was followed up until hospital discharge and the number of deaths were recorded and parameters involved with increased mortality were noted. Morbidity was assessed using the following variables Systemic Inflammatory Response Syndrome(SIRS), Sepsis, MODS, septic shock, acute renal failure, seizures, hypoglycemia and hyperbilurinemia .

Results: The difference in the CRIB II between neonates with and without sepsis, seizures, hypoglycemia and hyperbilirubinemia group was statistically not significant (P Value 0.162). But among the neonates with AKI, the median CRIB II was 8 (IQR 6 to 8) and it was 0 (IQR 0 to 2) in neonates without AKI. The difference in the CRIB II between neonates with and without AKI group was statistically significant (P Value <0.001). The difference between death and temperature, base excess, blood pressure was found to significant. Among the individual parameters of CRIB II and SNAP-PE II- the neonate's gestational age(prematurity),

temperature at admission, pH, APGAR score at 5mins, urine output(oliguria), Minimum FiO2 requirement at admission, Small for gestational age were found to be associated with poor outcomes-morbidity and mortality.

Conclusion: The scores of SNAPPE II and CRIB II was very beneficial tools in assess the severity of illness and prognosis in referred neonates.

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LIST OF ABBREVIATIONS

GLOSSARY	ABBREVIATIONS
AUC	Area under curve
BPD	Bronchopulmonary dysplasia
BSID	Bayley scales of infant development
BW	Birth weight
CLD	Chronic lung disease
CRIB	Clinical risk index for babies
ELBW	Extremely low birth weight
IQR	Interquartile range
IVH	Intra ventricular haemorrhage
LAMA	Left hospital against medical advice
LBW	Low birth weight
LOS	Length of hospital stay
MDI	Mental development index
NBRS	Nursery neuro biologic risk score
NCIS	Neonatal critical illness score
NEC	Necrotizing enterocolitis
NICHD	National institute of child health and human development
NICHHD	National institute of child health and human development
NICU	Neonatal intensive care unit
NMPI	Neonatal mortality prognostic index
NTISS	National therapeutics interventions scoring system
PDI	Psychomotor development index
PREM	Prematurity risk evaluation measure
PS	Pulmonary surfactant
ROC	Receiver operating characteristic
SE	Standard error
SNAP	Score for neonatal acute physiology
SNAP-PE	Snap perinatal extension

TISS	Therapeutic intervention scoring system
VLBWIs	Very low birth weight infants

INTRODUCTION

INTRODUCTION:

Neonatal mortality has continued to be a serious issue across the world as the consensus in 2010 reported around 15 million infants were born prematurely, and among them, more than 1 million infants died due to prematurity.[1] These numbers has been increasing due to multiple births due to fertility treatments among both young and older women.[2] According to the WHO publication in 2012, it was reported that 13% of all births in India were preterm births. Nearly 33.4 lakh preterm infants have been estimated to be born in India in 2015 which contributes to 22 % of the global preterm births.

The neonatal mortality in India accounted for nearly 0.75 million infants in the year 2013 and had recorded highest amongst any other country in the world.[3] However, the recent reports have recorded 28 neonatal deaths per 1000live births.[4] The early neonatal mortality of 22 per 100 live births showed mortality in the first week of life and accounted for about 45 % of total death under five years of age.[4] According to regional, global and country reports 2013, the major two etiology for neonatal death in India was found to be complications from preterm birth and sepsis.[3] The other two causes for neonatal death reported by other study was asphyxia and congenital malformations.[5] The associated morbidities among neonates include respiratory infections, septicemia, diarrhea and pneumonia until 6 weeks of neonatal age.[6]

Around 30 % of infants are born with low birth weight accounting for about 42% of burden across the globe. Nearly 60% of them born at term may be due to fetal growth restriction, and 40 % are preterm.[7] Few reports specify that LBW neonates were 11 to 13 times more risk of death than with normal weight neonates.[8] The incidence of neonatal sepsis according to hospital studies is 30 per 1000 live births and among the community based studies showed 2.7-17% of all live births.[8] Around 25% of infants suffering from sepsis die in the hospital and survived

ones increase the burden of associated morbidities such as neurological disabilities later in life.[9] Thorough evaluation of these morbidities in the NICU (Neonatal Intensive Care Unit) becomes vital to predict the risk of mortality in the intensive care followed by providing prime evidence for health care systems and research studies.[10] Thus, it is important to use uniform and well-accepted systems among the health providers to thoroughly evaluate high-risk neonates. [10]

Over the years, various tools or scoring systems have been developed in order to assess and predict the risk of mortality rate among new-born. These tools also aimed to reduce the problems of variation in birth weight, mixed etiology for neonatal death and difference in the care at the intensive unit and other factors which lead to mortality among neonates.[10] The scoring systems such as the SNAP perinatal extension (SNAPPE), clinical risk index for babies (CRIB) and Score for neonatal acute physiology (SNAP) have been profoundly used to judge the risk of sickness in neonates.[11]

The score CRIB II was recently developed to speculate the peril of death involved initially among neonates with low birth weight. The utilization of this system of scoring has been very minimal in evolving countries.[10] CRIB II has shown to be a standardised, easy and an accurate tool in predicting mortality independently compared to other scoring systems.[10] This scoring system is a validated scoring system which predicts the risk of mortality and the intensity of illness at the initial hour of birth. The parameters which this score considers are gestational age, body temperature, gender, birth weight and base excess of infants. The score range of 0-27 was considered and lowest scores indicate the most favorable outcome. In contrast, higher CRIB II scores of 11 and greater, gestational age 28 and less, birth weight 1100 and less, all contribute to increased risk infant increased mortality.[10]

The SNAP score was modified by Richardson to develop SNAP-PE in predicting mortality among infants. This modified score is comparatively good in predicting mortality regardless of the gestational ages, but not in predicting morbid conditions of the neonates.[12] The most popular scores SNAP, and APGAR scores 5 min is also a vital tool in predicting outcomes and in deed helping the family and parents to make the most of medical help with immediate interventions. Hence it important for all medical workers to provide an active and competent treatment with good quality of care in preventing any complications in very initial hours of infants life.[13]

Various studies have individually applied these scoring systems in NICU in predicting neonatal morality. Daga, A et al[14], reports showed high CRIB II score for infants with acute kidney injury, whereas Fortes Filho, JB et al[15], witnessed higher SNAP-PE II score in infants with retinopathy. The past reports[16, 17], compared scores NTSS, CRIB, SNAPPE and SNAP among the premature neonates and showed that CRIB scores to be a more apt and easy method to perform in daily clinical practice than others. Later few studies[18], showed that all the four scores had equal predictability but however the SNAPPE scoring was good enough on predicting long term outcomes and others were good in predicting illness and mortality at short term.

Need for the study:

These scoring systems help in predicting mortality and morbidity and may improve the validity of assessing the outcome among different hospitals and units. The life span of neonates in the ICU is depends on the potential and expertise of the working intensive care doctors to apply the suitable prognostic tools. Studies till date have generalized the estimation of mortality and morbidity of neonates admitted to NICU. Hence the data with respect to morbidity and mortality among NICU is not well focused due to neonates born at home, and delayed newborn admission. Outborn neonates have been previously admitted to a different institution or might

be home delivered, and sometimes older at the time of admission. There is a delay in active intervention among these neonates due to difficulties arousing during referral and transport . Due to above-mentioned differences, morbidity and mortality pattern may be different from those found in the inborn unit and such data are lacking in India and globally. With this background, this study aims to document the morbidity and mortality pattern of these neonates and review their management to identify areas that need improvement, to optimize their care. Hence the present research was conducted to compare the scores CRIB and SNAP -PE II in identifying morbidity and mortality of referred neonates in a hospital set up.

AIMS & OBJECTIVES

AIMS AND OBJECTIVES:

- To carry out the CRIB and SNAP-PE II score on all referred neonates in R L Jalappa Hospital.
- To follow up on these neonates during their stay in the NICU to identify morbidity and mortality.
- To find out the parameters of the two scores which are associated with poor morbidity and mortality.

REVIEW OF LITERATURE

REVIEW OF LITERATURE:

Global burden of Neonatal mortality

The neonatal mortality rate is defined as the total sum of deaths of the neonates per one thousand live births in a given year or another duration The peril of death is intense in the neonatal period from birth to first 28 days of life.[19] Around 3 million children die in the first 28 days after birth in every year. Preterm birth, asphyxia and sepsis are the major complications that lead to neonatal mortality.[20] About 31.9% of deaths of neonates happen in the early neonatal period and 9.7% in the late neonatal period.[21]

In the year 2013, throughout the world, 6.3 million children and young adolescents died. Of this 85 % of mortality occurred in the first 28 days of life. Globally, around 18 deaths/1000 live births are the probability of deaths in the first 28 days of life. There was a decline from 37 deaths/1000 live births to 18/1000 live births in neonatal mortality rate worldwide from the year 1990 to 2017.[4]

The under -5, infant and the neonatal mortality rate is 67, 48 and 29 deaths per 1000 live births as per Ethiopian Demographic Health Survey. One third of the world neonatal mortality burden is contributed by Africa. About 75% of deaths happen during the first week of life in Africa.[22]

Since 2000 there is a reduction in the childhood mortality rate. In 2015, around 5.9 million under-five children died worldwide. Of these, the prevalence of neonatal mortality is 45%. The reduction in the neonatal mortality is less with 47% as compared to post-neonatal under-five mortality with 58%.[23] There is a decline from 49 deaths/1000 live births to 29/1000 live births in neonatal mortality rate from the year 2000 to 2016.[24]

Burden of neonatal mortality in India

India has the highest number of deaths among the newborn and children under the age of 5 years in the world.[25] The largest number of global deaths in children younger than 5 years happened in India in the year 2015.[26] More than 98% of the deaths of neonates occur in the developing countries.[21] The neonatal mortality rate in urban India is 15/1000 live births and 31/1000 live births in rural India.[27] Between the year 1990 and 2013 the reduction in the neonatal mortality rate was only 19 units per 1000 live births.[25]

Around 1.5 million deaths occur in children younger than 5 years in India in the year 2015. Of these, the prevalence of deaths in the neonatal period is 57.9%. Preterm complications, intrapartum related events and sepsis are the causes of the neonatal events with 25.5%, 11.1% and 7.9%.[26]

Low income and middle-income countries account for around 99% of neonatal deaths. The prevalence of death in babies before they complete their first month of life in India is around one million. It reports for 1/4th of the global burden. In 2010, the neonatal mortality rate was 32 per 1000 live births in India.

In India, from 1991 to 2000, there was a reduction in the neonatal mortality rate from 51 deaths/ 1000 live births to 44 deaths/1000 live births. There was a decline from 40 deaths per 1000 live births to 34 per1000 live births in neonatal mortality rate in India from the year 2001 to 2009.[28]

Factors associated with neonatal mortality among refereed infants:

Perinatal deaths account for 7% of the global burden of disease, with developing countries contributing about 98% of deaths. Some of the facets related with neonatal mortality are adverse pregnancy outcomes including birth weight, gestational age, delivery complications and delivery methods. If quality focused on antenatal care, intrapartum care, these factors can be preventable.[29] The other factors affecting neonatal mortality are nutritional status, consultation of a traditional practitioner, and a neonatal disease. Most in-hospital deaths are due to events that occurred prior to hospitalization.[30] The first 28 days of life- the neonatal period is the most vulnerable time for a child's survival. Globally, neonatal mortality has seen a downward trend in recent years. The vital conditions related with neonatal death were infections, respiratory distress, prematurity, neonatal jaundice, sepsis, infections birth asphyxia and other neonatal conditions. Clean birth practices have shown to significantly reduce neonatal mortality.[31] Very early neonatal mortality is closely related to the condition of the newborn at birth, the monitoring of the pregnancy, and medical procedures.[32]

In a cross-sectional study performed by Seid, SS et al[24], in a population of 3276 the factors associated with the neonatal mortality were a parental residency, duration of hospital stay, low birth weight, prematurity, respiratory distress syndrome, perinatal asphyxia and congenital malformation.

In a cohort study conducted by Al Kibria, GM et al[33], in 21,227 neonates the neonatal mortality was high in male neonates, babies born before thirty-four weeks of gestation, babies who were twins or triplets and first born child. Also, the study concluded the positive association between the maternal age 30-35 years, history of child deaths and delivery complications with the neonatal mortality.

In a population of 683 neonates a retrospective cross-sectional study was conducted by Mamba, C et al[34], in which less than 5 survival infants from, mother, low birth weight, gestational age pregnancy anemia, less than 36 weeks, caesarean delivery, pregnancy malaria and antenatal visits number less than 3 are the factors having association with the neonatal mortality.

Table 1: Risk factor for neonatal mortality in various studies

Studies	Population	Risk factors
Kassa, RT et al.[21]	300	• Poor antenatal care • Assisted vaginal delivery • Cesarean delivery • Gestational age • Low birth weight • Sepsis • asphaxia
Osrido, TT et al[35]	964	• Multiple birth • Poor antenatal care • Cesarean delivery • Not initiated breast feeding within 1 hour of birth • Neonates resuscitated • Hyaline membrane disease • Perinatal asphyxia
Ghotbi, N et al[36]	415	• Maternal passive smoking during the passive years • less than 3 years of Pregnancy interval • Placental abruption • Age of gestation • Low birth weight • Malformations • Asphyxia
Reyes, J et al[37]	1410	• Gestational age <37 weeks • Birth weight ≤ 1500 grams • Moderate or severe respiratory distress at 10 minutes • APGAR score <7 at 5 minutes • Congenital malformation • Poor antenatal care
Ruhanga, M et al[38]	183	• Gestational age of<37 weeks • Low birth weight • APGAR score <7 • Referral neonates
Garcia, LP et al[39]	15,879	• Poor antenatal care • Low APGAR score • Prematurity • Low birth weight • Malformations

Samuel, D et al[40]	332	• Low APGAR score • Induced labor • Duration of labor>18 hours • Time of rupture of membrane >12 hours • Birth order 5 or above

Scoring systems used to predict the outcomes in neonates:

Sickness severity scores are widely used for neonates taken admission in NICUs to predict severity of illness and possibility of death and long-term outcome. These scores are also used frequently for quality assessment among different NICUs and hospital. Accurate and reliable measures of severity of illness are required for unbiased and reliable comparisons, especially for benchmarking or comparative quality improvement care studies. These scores also serve to control for population differences when performing studies such as clinical trials, outcome evaluations, and evaluation of resource utilization. Although presently, there are multiple scores designed for neonates' sickness assessment but none of the score is ideal. Each score has its own advantages and disadvantages.[41]

Clinical Risk Index for Babies (CRIB):

Tarnow-Mordi et al.[42] published a scoring system, the clinical risk index for babies (CRIB), that took into account 6 parameters namely birthweight, gestational age, a maximum and minimum fraction of inspired oxygen (FIO2), maximum base shortage during the first 12 hours and presence of congenital malformations. This score was developed in the U.K. and is mainly used in Europe. This score was developed retrospectively in a cohort of 812 neonates of birthweight ≤1500 g or gestational age less than 31 weeks, who were treated in four UK tertiary hospitals between 1988 and 1990. The discriminatory ability (area under the receiver operating characteristic ROC curve: Az) for predicting death was significantly greater for CRIB (Az= 0.90) than for birthweight alone (Az= 0.78).

Clinical Risk Index for Babies II (CRIB II):

CRIB II score, is an updated version of CRIB and was published by Parry et al. in 2003.[43] The superiority of CRIB II over CRIB is that it provides a recalibrated and simplified scoring system that avoids the potential problems of early bias related to treatment. A score of CRIB II is a measure of initial risk for death and illness severity within one hour of admission. It takes into account five parameters namely gestational age, body temperature, birth weight, base excess and gender of infant.[43]

The CRIB II has been validated by a recently published study from Egypt that enrolled 113 neonates and stated that CRIB II score was more accurate with Az = 0.968 and good calibration (HL test, p = 0.952) to predict neonatal mortality when contrasted to gestational age (Az = 0.900) or birth weight (Az = 0.834) alone.[10]

Score for Neonatal Acute Physiology (SNAP):

The original Score for Neonatal Acute Physiology (SNAP) was developed by Richardson et al. in 1990. This score was developed in the United States (US) and is mainly used in the US and Canada. SNAP scores the worst physiologic derangements in each organ system in the first twenty-four hours. This score is extensive and involves 28 physiological parameters. These physiological parameters change over time and as such the SNAP score was designed for sequential measurements.[44] According to Sutton et al.[45] SNAP is an useful measure of severity of illness in sick term neonates admitted to a tertiary NICU and SNAP can be used to foresee neonatal mortality and morbidity.

SNAP Perinatal Extension (SNAP-PE):

According to Richardson et al[46], perinatal risk factors also affect neonatal mortality independently, hence SNAP score was extended to its perinatal extension (SNAP-PE) by adding three additional perinatal parameters namely birth weight, small for gestational age, and five minute APGAR score. Therefore, making quantification of both physiological instability parameters and perinatal risk factors in one score.

SNAP-II, SNAPPE-II:

As the major drawback of SNAP and SNAP-PE was a large number of components, Richardson et al. simplified neonatal illness severity and mortality risk score and published SNAP-II and SNAPPE-II.[47] These scores were derived from a cohort of 25,429 neonates across 30 NICUs in Canada, California, and New England during the mid-1990s. SNAP-II was derived from the most parsimonious logistic model for in-hospital mortality using 10,819neonates. The components of SNAP-II include six physiologic items during a 12-hour period namely lowest mean blood pressure, lowest temperature, PO2/FIO2, lowest serum pH, presence of multiple seizures, and low urine output. SNAP-II has a score range of 0 (low severity) to 115 (high severity) and was designed to be used in neonates of all gestational ages. SNAPPE-II score was derived from the remaining 14,610 cases and similar to SNAPPE, there are three additional parameters in SNAPPE-II over SNAP II namely birth weight, small for gestational age, and five-minute APGAR score. Like SNAP-PE, SNAPPE-II measures the combined physiological and perinatal risk variables, thus improving the prediction of neonatal mortality. The maximum score achievable in SNAPPE-II in the sick neonate is 162.

National Therapeutics Interventions Scoring System (NTISS):

National Therapeutics Interventions Scoring System (NTISS) is a modified version of the Therapeutic Intervention Scoring System (TISS). From the 76 original TISS items, 42 were deleted and 28 added to form the NTISS thereafter making a total of 62 variables. Like TISS, NTISS assigns score points from 1 to 4 for various intensive care therapies. The advantage of NTISS score over other scores is that its basis is treatment and intervention rather than pathophysiological measurements such as used in CRIB, SNAP, SNAP-PE and their updates. The disadvantage includes numerous components in the scoring system making it lengthy and tedious for calculations.

National Institute of Child Health and Human Development score (NICHHD):

To foresee the danger of deaths in neonates weighing between 501 to 1500 grams Horbar, JD et al[48], developed a model based on admission factors which rises the mortality risk. These factors were decreasing birth weight, the appropriate size for gestational age, male gender, nonblack race, and 1-min APGAR score of ≤ 3. However, this score has not been used extensively since its development.

Neonatal Mortality Prognostic Index (NMPI):

Garcia et al. elaborated and assessed the degree of validity of a prognostic model. The variables that constituted the neonatal mortality prognostic index were paO2/FiO2 ratio x O2 saturation, gestational age x birthweight, cardiac arrest, major congenital malformations, septicemia and base excess.[49] This model showed to have a sensitivity of 70% and a specificity of 91% during the elaboration cohort. In the validation cohort, this model showed a sensitivity of 68%, specificity of 92%, the positive predictive value of 80%, the negative predictive value of 85%

and correct classification rate was 84%. This score has not gained too much popularity and is being used rarely.

Nursery Neuro biologic Risk Score (NBRS):

Brazy, JE et al[50], developed a Nursery Neuro biologic Risk Score (NBRS) based on potential mechanisms of brain cell injury in preterm neonates and showed correlation with the developmental outcome at the corrected ages of 6, 15, and 24 months. The NBRS correlated significantly with the Bayley Scales of Infant Development (BSID), Mental Development Index (MDI) (r = -0.61 to -0.40), Psychomotor Development Index (PDI) (r = -0.59 to -0.46), and with abnormal neurologic examination findings (r = 0.59 to 0.73) at the three testing periods. In original NBRS score total of 13 parameters were included. A shorter, revised NBRS that included only the seven parameters demonstrated a similar correlation with the developmental outcome when compared to original NBRS. A revised 2-week score of ≥ 5 ora discharge score of ≥ 6 demonstrated 100% specificity and 100% positive predictive value for an abnormal outcome at 24 months of age in these infants.

Prematurity risk evaluation measure (PREM score):

It is a graphical tool for predicting survival in very preterm (22-31 week) birth. It is based on gestation, birth weight for gestation and base deficit from umbilical cord blood. Cole et al. studied 1456 non-malformed very preterm neonates of 22-31 weeks' gestation born in 2000-2003 and 3382 births of 23-31 weeks born in 2000-2004 and concluded that PREM score can be used to predict the chance of survival at or before birth almost as accurately as existing measures.[51]

Berlin Score:

Maier et al.[52] studied on 572 VLBW neonates (396 neonates for score development and 196 for score validation) and produced the risk of death score by using multiple regression analysis. It included birth weight, APGAR score at 5 minutes, base excess at admission, the severity of respiratory distress syndrome, and artificial ventilation. Berlin score ranges from 3 to 40. It also has good discriminatory ability (Az = 0.86) with good validation (HL test p>0.05). Advantage of this score is its very early estimation of death risk (at admission) in comparison to CRIB score and SNAP score that are evaluated at 12 hours and 24 hours respectively. This score allows early randomization based on the risk of mortality. It also helps to differentiate treatment effects and variations in mortality risk over time.

SINKIN score:

Sinkin et al.[53] developed a score to predict the risk of chronic lung disease (CLD). It includes birth weight, gestational age, 5-minute APGAR score, and peak inspiratory pressure at 12 hours for12-hour-old neonates. Neonates were classified into low, moderate or high-risk groups on the basis of their predicted probability of requiring oxygen supplementation at 28 days; low =probability of less than twenty-five percent, moderate = probability of 25% to 75%, and high = probability greater than 75%. Regression analysis for 12 hours of age classified 125 neonates at low risk of whom 9% required supplemental oxygen at 28 days, and 80 neonates at moderate risk of whom 33% required supplemental oxygen at 28 days.

Most relevant studies assessing the role of CRIB Scoring:

Global studies:

Heidarzadeh, M et al[54] (2016), had assessed the value of CRIB- II in predicting mortality risk in preterm and low birth weight infants in East Azerbaijan- Iran. All infants ≤ 32 weeks' gestational age or ≤ one thousand five hundred gr birth weight were included in the study using the consecutive method. After calculating CRIB- II score, follow up of infants at 3 months of age and their outcome was determined. Of total 215 infants, 64 infants (29.7%) died in the hospital and one infant (0.4%) died after discharging from the hospital. 150 (68.8%) infants, were alive at 3 months age follow up. The mean of CRIB- II score in the group of dead infants was higher and statistically significant compared to the group of alive infants ($P<0.05$). The prediction power of CRIB- II was determined at 8.5 cut off point regarding the outcome of infants. Based on AUC, the CRIB- II score predicted 83% of mortality rate in infants (confidence interval =76-90). Authors have concluded that the CRIB- II had notable power of in predicting infants' mortality.

Xia, H et al[55] (2016), applied CRIB in low birth weight preterm neonates to assess the initial severity of illness, predict mortality risk rates, evaluate their own performance, and audit the performance between different medical institutions. The scoring system is able to correctly predict mortality probabilities and long-term neurodevelopmental outcomes for low birth weight preterm infants.

Ezz-Eldin, ZM et al[10] (2015), evaluated the CRIB II efficacy score as a tool to predict the risk for mortality of neonates among the babies with LBW admitted to neonatal intensive care unit at a tertiary care facility Kasr El-Aini paediatric hospital, Cairo, Egypt. Prospective cohort study design where one hundred and thirteen neonates, were included. On admission, arterial blood

gas analysis neonatal examination, history taking, and CRIB II score variables were done. The total deaths in the included cohort was 34.5% (31/113). Significant positive correlations were found between birth weight, excess base, temperature, gestational age, CRIB II score and the occurrence of mortality and with a progressive increase in mortality with increasing CRIB II score (p=0.001). gestational age </= 28, birth weight </= 1100 and CRIB II score >/= 11 showed significant association with neonatal mortality. CRIB II score with a cutoff point of >/= 11 was the most sensitive (94.9%) with the predictive value (74.0%) and specificity (82.4%) compared to birth weight and gestational age. CRIB II score showed good calibration to predict neonatal mortality as demonstrated with Hosmer-Lemeshow goodness of fit test (p= 0.952). Study findings have concluded that CRIB II score is a valid tool of initial risk assessment in LBW, predicting outcome more accurately than birth weight or gestational age alone. It is easily applicable and should replace the traditional models as a predictor of neonatal outcome.

Bruno, CJ et al[56] (2015), used CRIB scores as a tool for assessing risk for the development of pulmonary hypertension in extremely preterm infants with bronchopulmonary dysplasia. Severe bronchopulmonary dysplasia increases the risk of developing pulmonary hypertension. Higher CRIB scores correlate with pulmonary hypertension development in infants with bronchopulmonary dysplasia. CRIB scores help to categorize preterm infants early with a higher likelihood of developing pulmonary hypertension.

Marete, IK et al[57] (2011). Focused on the use of CRIB II score as a tool to anticipate the risk for neonatal deaths among the low birth weight babies at KNH. It was a prospective cohort study. Follow up of A total sample of 135 LBW babies was done from admission till discharge, the 28th day of life or death whichever came first. One hundred and thirty-five newborns were enrolled into the research. Range of birth weight was from 600-2500 g, with a median of 1600g.

Total CRIB II score ranged from 1-15, with a median of 5.5. Gestational age had a range of 26 - 38 weeks. Total mortality was 45.9%. Birth weight < 1500 g, gestational age < 30 weeks, base excess <-12 mmol/l, the temperature at admission > 37.5 or < 35 (all components of CRIB II) and total CRIB II score of > 4 were all found to be significantly associated with hospital neonatal mortality. Using a cutoff point of 4, CRIB II score was found to have a sensitivity of 80.6%, specificity of 75.3%, and a predictive value of 77.7% compared to 72.5, 71.2, and 71.8% respectively for birthweight. Gestational age was found to have even lower figures; 56, 75 and 66% for sensitivity, specificity and predictive values respectively. Findings of the study support the reality that CRIB II score of > 4 was found to have a better prediction for mortality among the LBW babies compared to the traditionally used predictors and can be used to prioritize care for such neonates for a better outcome.

Brito, AS et al[58] (2003), evaluated the mortality rate of very low birth weight babies born at a NICUs during a specified period of time according to variations in CRIB (Clinical Risk Index for Babies) birth weight score, and gestational age. Two hundred and eighty-four infants met the inclusion criteria. Mean gestational age was 30.2 +/- 2.4 weeks (median=30.0) mean birth weight was 1,148 +/- 248 g (median=1,180), and mean CRIB score was 3.8 +/- 4.4 (median=2.0). The neonatal mortality rate was 23.2%, varying according to mean birthweight <750 g (72.7%), gestational age <29 weeks (57.1%) and CRIB score >10 (79.4%). Receiver Operating Characteristic (ROC) curves were composed for CRIB score, gestational age and birth weight to assess the capacity of each to forecast deaths in hospitals and the areas under the curve were respectively 0.88, 0.76 and 0.81. Sensitivity, specificity and predictive values were evaluated, and all variables were considered predictors of mortality ($p<0.0001$). The optimal cut off point based on the ROC curve for the CRIB score was 4 with sensitivity 75.8%, specificity 86.7, positive predictive value 63.3% and negative predictive value 92.2%. CRIB

score higher than 4 proved to be a better predictor of mortality when compared to birthweight and gestational age.

Indian Studies:

Rastogi, PK et al[59] (2010), conducted a study to validate the Clinical Risk Index for Babies (CRIB II) score in predicting the neonatal mortality in preterm neonates ≤32 weeks gestational age. A prospective cohort study was undertaken at a tertiary care neonatal unit. 86 consecutively born preterm neonates with gestational age ≤32 weeks were involved. The five variables related to CRIB II were recorded within the first hour of admission for data analysis. The receiver operating characteristics (ROC) curve was used to check the accuracy of the mortality prediction. H-L Goodness of fit test was used to see the discrepancy between observed and expected outcomes. A total of 86 neonates (males 59.6%; mean birth weight: 1228± 398 grams; mean gestational age: 28.3 ± 2.4 weeks) were enrolled in the study, of which 17 (19.8%) left the hospital against medical advice (LAMA) before reaching the study endpoint. Among 69 neonates completing the study, 24 (34.8%) had an adverse outcome during the hospital stay and 45 (65.2%) had favorable outcome. CRIB II correctly predicted an adverse outcome in 90.3% (Hosmer-Lemeshow goodness-of-fit test *P*=0.6). The area under the curve (AUC) for CRIB II was 0.9032. In intention to treat analysis with LAMA cases included as survivors, the mortality prediction was 87%. If these were included as having died, then mortality prediction was 83.1%. The CRIB II score was found to be a good predictive instrument for mortality in preterm infants ≤32weeks gestation.

Khanna, R et al[60] (2002), studied to assess the usefulness of clinical risk index of babies (CRIB score) in predicting neonatal mortality in neonates with extremely preterm birth, compared to gestation and birth weight. Ninety-seven preterm neonates with age of gestational less than 31

weeks or birth weight less than or equal to 1500 g were enrolled for the prospective longitudinal study. Relevant neonatal data was recorded. Blood gas analysis results and the maximum and the minimum FiO_2 required by babies in the first 12 hours of life were noted. Mortality was taken as death while the baby was in the nursery. The prognostication of mortality by gestational age, birth weight and CRIB score was done using the Logistic model and expressed as area under the ROC curve. The area under the ROC curve for birth weight, gestational age and CRIB score was almost the same, the areas being 0.829, 0.819 and 0.823 respectively. Hence CRIB score did not cope better than gestational age and birth weight in foreseeing neonatal mortality. The CRIB score did not improve on the ability of birth weight and gestational age to anticipate neonatal deaths in the study.

Most relevant studies assessing the role of SNAP PE Scoring:

Global studies:

Muktan, D et al[61] (2019), carried out the study to assess the validity of SNAPPE-II score (Score for Neonatal Acute Physiology with Perinatal Extension-II) as a predictor of neonatal mortality and duration of stay in NICU. This prospective, observational study was on Two hundred fifty-five neonates, and SNAPPE-II score was calculated. Results showed that out of 255 neonates, 45 neonates (17.6%) died and 210 were discharged. SNAPPE-II score was significantly higher among neonates who died compared to those who survived [median (IQR) 57 (42–64) vs. *22* (14–32), $P < 0.001$]. SNAPPE II score had discrimination to predict mortality with the area under the ROC Curve (AUC): 0.917 (95% CI, 0.854–0.980). The best cut - off score for predicting mortality was 38 with sensitivity 84.4%, specificity 91%, positive predictive value 66.7% and negative predictive value 96.5%. They concluded that SNAPPE- II is a useful tool to anticipate neonatal mortality in NICU.

Radfar, M et al[62], determined the utility of Score for Neonatal Acute Physiology II (SNAP II) and Score for Neonatal Acute Physiology with Perinatal Extension II (SNAPPE II) scoring systems as predictors of neonatal mortality rate and comparing the predictive value of these two methods. It's a prospective study which recorded demographic data, APGAR score at 5 minutes after birth, initial and final diagnosis, SNAP II, and SNAPPE II were recorded within 24 hours after admission to the NICU. One hundred ninety-one newborn infants entered into the study. Birth weight (2555 +/- 722 g in survival group versus 1588 +/- 860 g in expired group, P<0.001), and APGAR score more than 7 at 5 minutes after birth (99.4% in survival group versus 57.1% in expired group, P<0.001) were significantly related to the mortality rate. SNAP II (area under the curve [AUC] = 0.992; 95% CI: 0.98-1) and SNAPPE II (AUC = 0.994; 95% CI: 0.984-1) had better value for predicting the patients' survival compared to APGAR score at 5 minutes after birth (AUC = 0.711; 95% CI: 0.568-0.855). They concluded that although there was no significant difference between SNAP II and SNAPPE II, both methods had a much better predictive value compared to the APGAR score at 5 minutes after birth.

Ucar, S et al[63], aimed to determine the efficacy of SNAPPE-II in predicting mortality in extremely low birth weight infants (ELBW) and also assessed its efficacy in predicting the potential causes of neonatal morbidity. Data from infants with a birth weight less than 1500 gr were collected in a retrospective manner. SNAPPE-II score was calculated for the first twenty-four hours of each infant. The efficacy of SNAPPE-II score in predicting intra ventricular hemorrhage (IVH), necrotizing enterocolitis (NEC) and bronchopulmonary dysplasia (BPD) as well as mortality was evaluated. A total of 182 infants (98 males and 84 females) were enrolled and the mean birth weight was 1,134 ± 264 g. The most notable scores documented for SNAPPE-II were 33 for mortality (sensitivity 86.6%, specificity 76,4%), 23 for IVH (sensitivity 88.2%, specificity 64.6%), 39 for NEC (sensitivity 78.7%, specificity 72.6%) and 36 for BPD

(sensitivity 87,8%, specificity 69,4%). Infants with a high SNAPPE-II score had significantly higher rates of IVH ($p < 0,001$), NEC ($p = 0,014$) and BPD ($p = 0,003$). They concluded that a high score of SNAPPE-II in premature infants had an independent association with neonatal mortality as well as with factors know to be associated with neonatal morbidity, such as IVH, NEC and BPD.

Dammann, O et al[64] (2009), conducted a study on interinstitutional variation in the prediction of death by SNAP-II and SNAPPE-II among extremely preterm infants. A total of 1467 infants born before the 28th postmenstrual week at 14 institutions were given Score for Neonatal Acute Physiology II (SNAP-II) and Score for Neonatal Acute Physiology Perinatal Extension II (SNAPPE-II) values based on data collected within the first 12 postnatal hours. The rate of death before postnatal day 28 was 13% (interinstitutional range: 7%-20%), whereas the overall mortality rate was 18% (8%-31%). SNAP-II values, SNAPPE-II values, and mortality rates tended to decrease with increasing gestational age. The positive predictive values of most SNAP-II and SNAPPE-II cutoff levels were close to 30%. In general, institutions' mortality rates increased with the proportions of infants whose SNAP-II values were >/=30. They concluded that the physiologic instability in the first 12 postnatal hours that is identified by illness severity scores conveys information about the risk of death among infants at the lowest gestational ages.

Indian Studies:

Harsha, SS et al[12], conducted the study to assess the validity of SNAPPE-II score as a predictor of mortality and morbidity. A total of 248 neonates who met the inclusion criteria were included in the study, and SNAPPE-II score was calculated. Receiver Operating Characteristic (ROC) curve was constructed to derive the best cut-off score. SNAPPE-II score was higher among expired neonates compared to survived ones. A mean score of 37 was associated with higher mortality. However, it didn't accurately predict the length of stay. They concluded that SNAPPE II score is a better predictor of mortality irrespective of gestational ages and it is not a good predictor of morbidity.

Vasudevan, A et al[65] (2006). Conducted a study that identified the profile of neonates admitted in pediatric ICU and validated the Score for Neonatal Acute Physiology (SNAP). A retrospective study was carried out in predicting the outcome in terms of deaths and length of hospital stay (LOS). Neonatal sepsis (51%) and birth asphyxia (11.2%) were the commonest indications for admission. Thirty-seven (38.1%) of the neonates died. The mean SNAP score in babies who died was 18.8 +/- 9.8 and 10.1 +/- 6.4 in survivors ($P<0.001$). There was no correlation between SNAP score and mean length of stay in hospital ($P=0.5$). They concluded that conclude SNAP correlates well with mortality in neonates admitted to the PICU.

Maiya, PP et al[66] (2001), assessed the validity of SNAP in predicting the outcome in terms of mortality, duration of hospital stay and to evolve the best cut-off SNAP scores for predicting mortality in different individual neonatal conditions. 295 consecutive newborn admitted to NICU during an eleven-month period were evaluated. The sensitivity and specificity of SNAP score > 15 in predicting mortality were 63% and 95% respectively. The positive and negative predictive values were 72% and 92.5% respectively. Very low birth weight babies and

ventilated preterm neonates had higher mortality, and the best cut-off SNAP score for predicting mortality in these groups was 10. By using multiple regression analysis on three variables including birth weight, gestational age and SNAP, SNAP was found to show the best correlation with mortality. On correlating SNAP with a duration of hospital stay, 76.8% of the surviving neonates with SNAP < 16 stayed for < 15 days, whereas the rest stayed longer despite low SNAP. All the 9 babies with SNAP > 15 who survived stayed for > 15 days. They concluded that SNAP is a measure of illness severity and correlates well with neonatal mortality SNAP scores > 10 in VLBW babies and > 15 in others are associated with higher mortality.

Comparative studies:

Shrestha, D et al[67] (2017), conducted a study to determine whether the Neonatal Acute Physiology (SNAP) scoring system (SNAP II) and with the perinatal extension (SNAP II PE) can be used to predict neonatal deaths in a resource-limited NICU in Nepal. A prospective observational study was carried out in NICU of Kanti Children's Hospital in Kathmandu, Nepal. Data required the SNAP II and SNAP II PE scores were collected and relationships between the SNAP II and SNAP II PE scores and neonatal mortality were analyzed. They found out that mortality was 83% (5/6) when SNAP II was >40, and 66.7% (6/9) when SNAP II PE was >50. A SNAP II score of ≥12 had a sensitivity of 75.9%, and specificity of 73.2% for predicting mortality, and a SNAP II PE score of ≥14 had a sensitivity of 82.8% and specificity of 67.0% for it. It is determined that SNAP II and SNAP II PE scoring of neonates can be used to predict prognosis of neonates in resource-limited NICUs in Nepal.

Chen, CY et al[68] (2017), studied to investigate the accuracy and clinical utility of neonatal critical illness score (NCIS) and score for neonatal acute physiology, perinatal extension, version II (SNAPPE-II) in predicting the "dead and abandoned" risk in critically ill neonates. A total of 269 critically ill neonates were divided into two groups according to their prognosis: dead/abandoned and improved/cured. The accuracy of these two scoring systems, NCIS and SNAPPE-II, in predicting the "dead and abandoned" risk was compared. It was proved that SNAPPE-II is more precise in early prediction of the "dead and abandoned" risk in critically ill neonates compared with NCIS. NCIS has the ability to predict the "dead and abandoned" risk in children in line with the individual indicator.

Asker, HS et al[69] (2016), evaluated the score for Neonatal Acute Physiology and Perinatal Extension II and Clinical Risk Index for Babies with additional parameters in five different centers in Southern Turkey. A total of 1668 inborn subjects admitted in NICU within the first 12 hours of delivery, and meeting the criteria of selection were included in the study. The SNAP-PE-II scoring system was applied to all patients, and the CRIB scoring system was used for 310 newborns with gestational age < thirty-two weeks and weighing <1500 g. SNAP-PE-II significantly predicted mortality ($P < 0.05$) compared with CRIB. It has been concluded that SNAP-PE-II was a significant predictor of mortality in newborns with birthweight <1500 g compared with CRIB.

Reid, S et al[70] (2015), compared CRIB-II and SNAPPE-II as mortality predictors for babies of less than 32 weeks gestation, very preterm infants. These infants born within a 2-year period, 2003 and 2004. CRIB-II and SNAPPE-II scores were collected. Both scores had good discriminatory ability (CRIB-II area under the curve 0.913, standard error (SE) 0.014; SNAPPE-II area under the curve 0.907, SE 0.012) and adequate goodness of fit (HL

$\chi 2 = 11.384$, 8 degrees of freedom, P = 0.183 for CRIB-II; HL $\chi 2 = 4.319$, 7 degrees of freedom, P = 0.742 for SNAPPE-II). Both can facilitate risk-adjusted comparisons of mortality and quality of care after the first post-natal 12 h. CRIB-II scores have the advantage of being simpler to collect and calculate.

Li, MA et al[71] (2012), aimed to describe the clinical features, treatments and prognosis of very low birth weight infants (VLBWIs) requiring mechanical ventilation, to assess the risk factors associated with the mortality of VLBWIs, and to evaluate the significance of the scoring system based on clinical risk index for babies (CRIB) and the score for neonatal acute physiology-perinatal extension II (SNAPPE-II) for predicting mortality risk for premature infants in China. They collected data from 127 VLBWIs requiring mechanical ventilation who were admitted to the NICU from January 2010 to October 2011. The enrolled infants had a mean gestational age of 31±2 weeks, a mean birth weight of 1290±170 g, a male/female ratio of 1.23∶1, and extremely low birth weight infant accounting for 6.3%. Of the 127 cases, 48.0% were administered with pulmonary surfactant (PS), and 49.6% received endotracheal intubation ventilation. The overall in-hospital mortality was 41.7%. Multivariate logistic regression revealed the following independent risk factors for mortality: low birth weight, multiple birth, cesarean section, and low PaO2/FiO2 ratio (OR = 1.611, 7.572, 4.062, and 0.133 respectively; P<0.05). SNAPPE-II and CRIB showed good performance in predicting prognosis, with areas under the ROC curve of 0.806 and 0.777 respectively. The overall mortality rate of VLBWIs is still relatively high. The high-risk factors for VLBWI mortality include low birth weight, multiple birth, cesarean section, and low PaO2/FiO2 ratio. The neonatal illness severity scoring system (using SNAPPE-II and CRIB) can be used to quantify illness severity in premature infants.

Mohkam, D et al[72] (2011), did a comparison of CRIB, CRIB II, SNAP, SNAPII and SNAP-PE scores for prediction of mortality in critically ill neonates. This prospective cohort study was conducted at the neonatal intensive care units of Mofid and Mahdieh hospitals between March 2006 and May 2009. They evaluated CRIB, CRIB II, SNAP, SNAPII and SNAP-PE score for each neonate and the final scores were then obtained. The predictive accuracy of these parameters was expressed as area under the receiver operative characteristic curve, sensitivity, specificity, positive predictive value and negative predictive value. They concluded that the neonatal scoring systems could be a useful tool for prediction of mortality in NICUs and SNAP can predict the mortality better than the others.

Eriksson, M et al[18] (2007), tested four neonatal severity-of-illness indices (CRIB, NTISS, SNAP, SNAP-PE) for their ability to predict short- and long-term outcome in very low-birthweight infants receiving neonatal intensive care. They took data on 240 newborns with birth weights below 1500 g from two Swedish neonatal units. An early adverse outcome (in-hospital death, severe haemorrhagic-ischaemic brain lesion, retinopathy, chronic lung disease) was better predicted with CRIB (area under ROC curve (Az) = 0.87) and SNAP-PE (Az = 0.86), while SNAP-PE was best for predicting late problems (deviations in growth and psychomotor development, neurosensory impairment, difficulties in concentration, and impairment in vision, and hearing,) (Az = 0.63). All indices predicted the early outcome better than the outcome at the 4-y follow-up.

Gagliardi, L et al[73] (2004), did an evaluation of the risk of mortality in very low birth weight infants and compared CRIB, CRIB-II, and SNAPPE-II. They took data from 720 VLBWI, admitted to 12 neonatal units in Lombardy (Northern Italy) and the discriminatory ability of the scores was assessed. CRIB and CRIB-II showed greater discrimination than SNAPPE-II (AUC

0.90 and 0.91 v 0.84, $p < 0.0004$). Risk adjustment using all scores is imperfect, and other perinatal factors significantly influence VLBWI survival. CRIB-II seems to be less confounded by these factors.

Zardo, MS et al[74] (2003), evaluated and compared birthweight and scores as predictors of neonatal mortality in a NICU. The survey included 494 newborns admitted to the NICU of a general hospital in Porto Alegre, southern Brazil, immediately after delivery, between March 1997 and June 1998. For CRIB (Clinical Risk Index for Babies) evaluation purposes, only patients born weighing up to 1,500 g were considered. ROC (Receiver Operating Characteristics) curves were calculated for SNAP (Score for Neonatal Acute Physiology), SNAP-PE (Score for Neonatal Acute Physiology--Perinatal Extension), SNAP II, SNAP-PE II, and CRIB scores, as well as for birth weight of the 494 patients studied, 44 died (8.9% mortality). Of the 102 patients born weighing up to 1,500 g, 32 (31.3%) died. The area below the ROC curves ranged from 0.81 to 0.94. There were no statistically significant differences between the areas obtained for all scores evaluated. All mortality risk scores evaluated performed better than birthweight, especially on newborns with birthweight=1,500 g. All neonatal mortality scores had better performance and were superior to birthweight as measures of in-hospital mortality risk for newborns admitted to NICU.

Pollack, MM et al[75] (2000), tested and compared published neonatal mortality prediction models, including Clinical Risk Index for Babies (CRIB), Score for Neonatal Acute Physiology (SNAP), SNAP-Perinatal Extension (SNAP-PE), Neonatal Therapeutic Interventions Scoring System, the National Institute of Child Health and Human Development (NICHD) network model, and other individual admission factors such as birth weight, low APGAR score (<7 at 5 minutes), and small for gestational age status in a cohort of VLBW infants from the

Washington, DC area. Data were collected on 476 VLBW infants admitted to 8 NICUs between October 1994 and February 1997. The standardised mortality ratios for the NICHD, CRIB, and SNAP-PE models were 0.65, 0.56, and 0.82, respectively. Discrimination of all the models was excellent (range: 0.863-0.930). Birth variables should be reassessed as a method to control for severity of illness in predicting mortality.

Relevant studies on referred neonates:

Bokade, CM et al[76], in their observational study, recorded the mortality and morbidity pattern among the infants who were referred. They analysed 1038 referred infants admitted to hospital and found 58.96% to be male and 41.04%. The study population was from a low socioeconomic status who had travelled 84.81 km who admitted their infants due to sepsis in 37.37%, respiratory distress syndrome in premature babies 14.55%, perinatal asphyxia 17.53%, jaundice in 9.73% and other reasons. The mortality among these infants was 31.98% without gender predilection. The etiology for the cause of death was sepsis in 34.94%, followed by asphyxia in 22.29% and respiratory distress in prematurity.

Kozuki, N et al[77] 2015, in a systematic review analysed and aimed to identify unpublished data on new-born transfer and completion rates. The data was collected from 3 sub-Saharan African countries and Asian countries where factors such a number of house visits during the neonatal period, the treat signs and referral rates were taken as variables for analysis. Neonatal referral completion rates ranged from 34 to 97 %, with a median rate of 74 %. Four studies reported data on the early neonatal period; early neonatal completion rates ranged from 46 to 97 %, with a median of 70 %. Existing literature reports a wide range of neonatal referral completion rates in Sub-Saharan Africa and South Asia following active illness surveillance.

Aggarwal, KC et al[78], study aimed to find out predictors of mortality among new-borns delivered elsewhere and admitted in a tertiary hospital. Hospital data for were retrieved and analysed for determining predictors for mortality of the new-borns. Time of admission, referral and presenting clinical features were considered. Out of 1496 infants included in the study, there were 300 deaths. About 43% of deaths took place in the first 24 hours of life. Asphyxia and low birth weight were the main causes of death in the early neonatal period.

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personnel during transport and referral from any hospital had a significant correlation with mortality.

A prospective observational study by Roa, SK et al[79] 2015, aimed determine the mortality rate of external arrival of sick infants and mode of neonatal transport at tertiary care Centre. This study included 200 infants only of age up to 28 days, delivered at home or private nursing home or any health centre; and excluded age more than 28 days and infants delivered in the institution of study. Out of 200 new-borns 146 were male and 54 were female, 140 were term and 59 were preterm, 39 new-borns expired and common mode of transport was taxi 47%, bus 16%, auto 16% and ambulance 2.5%. The common factors determining the outcome were low admission weight, prematurity, longer duration of transport and deranged physiological factors e.g. hypothermia, respiratory distress, prolonged CRT and central cyanosis. This study concluded that neonatal transport in India is self-supported; the ideal element of neonatal transport is a major gap in holistic neonatal care.

Narang, M et al[80] 2013, conducted a descriptive study to determine the predictors of mortality among referred infants and to determine their transport characteristics. A total of 300 consecutive neonates who were transferred to the centre were enrolled in the study. The following information were recorded: maternal details, birth details, interventions before transportation, details of transportation and neonatal condition at arrival. Detailed clinical assessment and management was done as per standard neonatal protocols. Birth weight <1 kg (OR 0.04; 95% CI: 0.006-0.295, P<0.01) and transportation time >1 hour (OR 5.58; 95% CI: 1.41-22.01, P=0.01) were found to be significant predictors for mortality among the transported neonate. Transport characteristics reflect road transport with the limited utility of ambulances and lack of trained health personal. Hence this study showed that very low birth weight and

lengthy transportation time were found to be significant predictors of neonatal mortality among the transported neonate.

A cross- sectional study by Sabzehei, MK et al[81], aimed at evaluating the factors influencing clinical complications of neonates referred to NICU. The total infants involved in this study were 100 with mean gestational age, and the mean birth weight were 37.5 ± 1.8 weeks and 2800 ± 605 g, respectively. The causes for neonate transfer were respiratory diseases (58%), need for surgery (21%), central nervous system diseases (9%), acute kidney injury (4%), fulminant sepsis (6%), and pathologic jaundice (2%). The mean time of transfer was 84 ± 42 min, being more than 120 min in 17% of the infants. Clinical complications occurred in 32% of the infants with hypotension (18%) and hypothermia (9%) as the most common clinical complications and acidosis and hypercapnia as the most common laboratory abnormalities caused by the transfer. This study suggested that the infants transferred from one centre to others should be done with most care, experienced persons and good equipment.

Goldsmita, G et al[82], study evaluated the risk factors involved during the infant transport to NICU. The number of neonates studied were 160 with GA 35 ± 3 weeks; birth weight (BW) 2482 ± 904 g and median age 2 days. Majority of infants were referred due to cardiorespiratory (50%) or surgical (34%) illnesses. Of them, 91 (57%) had clinical deterioration and 46% hypothermia. Forty-nine neonates required ICRS and 28 died (twelve before 7 days after admittance). Variables assessed were not associated with the risk of clinical deterioration. Mortality was higher in the group with clinical deterioration (OR: 3.34; 95% CI: 1.2-8.7), even when the severity of the clinical picture was considered (ORA: 3; 95% CI: 1.2-8.3). Clinical deterioration during transport was associated with the need for ICRS (OR: 2.4; 95% CI: 1.2-5). In our experience, transferred new-born infants often suffered the loss of stability or clinical

deterioration, regardless of their characteristics, and this was related to higher mortality. Therefore, it is critical to optimise care strategies

Lacunae in literature:

Neonatal severity of illness scores is useful for predicting illness severity and mortality risk and these scores have shown to be better or gestational age or birth weight alone. But, in recent past there are multiple changes in neonatal resuscitation, prenatal care and neonatal intensive care intervention, which necessitate the urgent need for formulation of new sickness severity score that take into account of the advances in field of neonatology. Furthermore there is lack of literature regarding the issues with transport, referral in particular with neonatal health care **,** absence of guidelines for stabilizing of neonates before referral, relatively few studies neonatal severity of illness scores in referred neonates**.** Therefore, still there is need for an ideal sickness severity score that determine accurate measurements and sequential outcome to improve neonatal critical care.

MATERIALS & METHODS

MATERIALS&METHODS:

Study site: This study was conducted in the department of pediatrics at Sick-Neonatal Intensive Care Unit(S-NICU), R L Jalappa Hospital

Study population: Neonate referred to Sick-Neonatal Intensive Care Unit(S-NICU), R L Jalappa Hospital during the period of study were considered as the study population.

Study design: The current study was a prospective observational study

Sample size: Sample size for the study estimated based on the variance of CRIB score reported in a study by Sarquis, AL et al[83], with a confidence interval of 95%, standard error of mean=0.594

The sample size calculated as 60 referred to neonates. Expecting a 10% dropout rate the sample size is calculated as 60+6 referred neonates.

Sampling method: All the eligible subjects were recruited into the study consecutively by convenient sampling till the sample size is reached.

Study duration: The data collection for the study was done between January 2018 to December 2019 for a period of 1 year.

Inclusion Criteria:

Referred Neonates admitted to SNICU at RLJH during the study period will be the study population.

Ethical considerations: Study was approved by institutional human ethics committee. Informed written consent was obtained from all the parents or guardians of the neonates (study participants) and only those participants whose parents were willing to sign the informed consent were included in the study. The risks and benefits involved in the study and voluntary nature of participation were explained to the participants parents before obtaining consent. Confidentiality of the study participants was maintained.

Data collection tools: All the relevant parameters were documented in a structured study proforma.

Methodology: All referred Neonates admitted at SNICU R L Jalappa Hospital were considered as the study population. At the time of enrolment, informed written consent was obtained from the parents. CRIB and SNAP-PE II score was applied at the time of admission to NICU and individual scores were obtained. Each neonate was followed up until hospital discharge and the number of deaths were recorded and parameters involved with increased mortality were noted. Morbidity was assessed using the following variables

1.Systemic Inflammatory Response Syndrome (SIRS)-Presence of two or more of the following:

Temperature >38.5^{o}C or < 36^{o}C

Heart rate > 160 beats per minute or < 80 beats per minute

Respiratory rate > 50/minute or mechanical ventilation

White blood cell count > [34 X 10^9/L] (0-6 days) / > [19 X 10^9/L] (7-28 days)[10]

2.Sepsis-SIRS with a suspected or confirmed infection[10]

3.Multi Organ Dysfunction Syndrome (MODS)-Potentially reversible physiological derangement involving two or more organ systems not involving the disorder that resulted in ICU admission[10]

4.Septic shock- sepsis and cardiovascular dysfunction[10]

5.Acute Kidney Injury-

nRIFLE criteria

Risk-urine output <1.5 ml/ kg/hour X 24 hours

Injury-urine output <1ml/kg/hour X 24 hours

Failure-urine output < 0.7 ml/kg/hour X 24 hours or anuria X 12 hours

Loss- Persistent failure > 4 weeks

End stage- End-stage renal disease (persistent failure > 3 months) [11]

6.Seizures

7.Hypoglycemia- GRBS < 45 mg/dl[12]

8.Hyperbilirubinemia requiring treatment- using hour specific bilirubin normogram[13]

Statistical Methods:

SIRS, Sepsis, AKI, seizures, hypoglycemia, hyperbilirubinemia, Dearth were considered as primary outcome variables.

Gestational age, APGAR score, Birth weight and SGA …etc were considered as explanatory variables.

Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency and proportion for categorical variables. Non normally distributed quantitative variables were summarized by median and interquartile range (IQR). Data was also represented using appropriate diagrams like bar diagram, pie diagram.

All Quantitative variables were checked for normal distribution within each category of explanatory variable by using visual inspection of histograms and normality Q-Q plots. Shapiro- wilk test was also conducted to assess normal distribution. Shapiro wilk test p value of >0.05 was considered as normal distribution.

For normally distributed Quantitative parameters, the mean values were compared between study groups using Independent sample t-test (2 groups). For non-normally distributed Quantitative parameters, Medians and Interquartile range (IQR) were compared between study groups using Mann Whitney u test (2 groups)

Categorical outcomes were compared between study groups using Chi square test /Fisher's Exact test (If the overall sample size was < 20 or if the expected number in any one of the cells is < 5, Fisher's exact test was used.)

P value < 0.05 was considered statistically significant. IBM SPSS version 22 was used for statistical analysis.[84]

OBSERVATIONS AND RESULTS

RESULT:

A total of 70 subjects were included in the final analysis.

Table 2: Descriptive analysis of gender in the study population (N=70)

Gender	Frequency	Percentages
Male	45	64.3%
Female	25	35.7%

Among the study population, 45 (64.3%) participants were male and remaining 25 (35.7%) participants were female. (Table 2 & Figure 1)

Figure 1: Bar chart of gender in the study population (N=70)

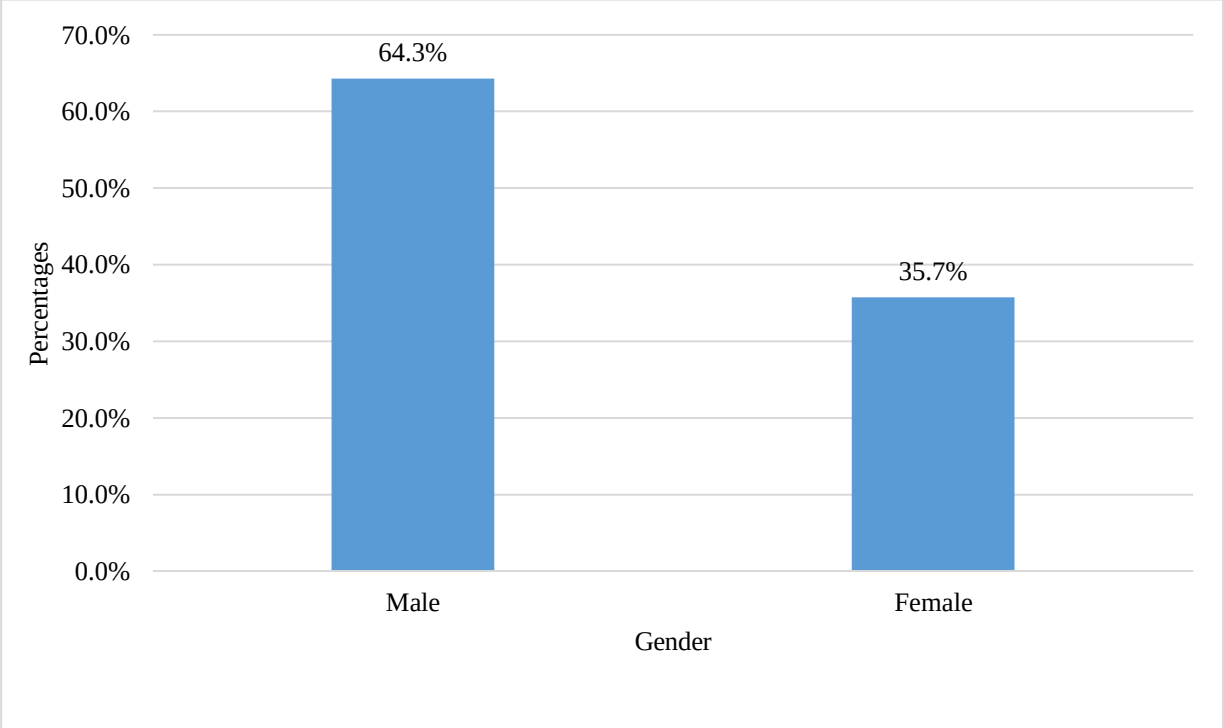

Table 3: Descriptive analysis of BP, temperature, Po2/Fio2, PH parameters in study population (N=70)

Parameter	Mean ± SD	Median	Minimum	Maximum	95% C.I	
					Lower	Upper
Mean Blood Pressure	53.21 ± 17.74	59.00	2.60	76.00	48.98	57.44
Temperature	97.02 ± 1.26	97.00	95.00	99.00	96.72	97.32
Po2/Fio2(Mm/hg)	3.66 ± 5.6	2.45	0.40	48.00	2.32	4.99
Ph	7.3 ± 0.12	7.34	7.11	7.52	7.27	7.33

The mean blood pressure was 53.21 ± 17.74 in the study population. Ranged between 2.60 to 76 (95% CI 48.98 to 57.44). The mean temperature was 97.02 ± 1.26 in the study population. Ranged between 95 to 99 (95% CI 96.72 to 97.32). The mean Po2/Fio2 was 3.66 ± 5.6 in the study population. Ranged between 0.40 (mm/hg) to 48 (mm/hg) (95% CI 2.32 to 4.99). The mean PH was 7.3 ± 0.12 in the study population. Ranged between 7.11 to 7.52 (95% CI 7.27 to 7.33). (Table 3)

Table 4: Descriptive analysis of urine output (ml/kg) in study population (N=70)

Parameter	Mean ± SD	Median	Minimum	Maximum	95% C.I	
					Lower	Upper
Urine Output (ml/kg)	1.2 ± 0.35	1.20	0.20	1.80	1.12	1.29

The mean urine output was 1.2 ± 0.35 in the study population. Ranged between 0.20 to 1.80 ml/kg (95% CI 1.12 to 1.29). (Table 4)

Table 5: Descriptive analysis of APGAR in the study population (N=70)

Parameter	Mean ± SD	Median	Minimum	Maximum	95% C.I	
					Lower	Upper
APGAR	7.46 ± 1.63	8.00	4.00	9.00	7.07	7.85

The mean APGAR score was 7.46 ± 1.63 in the study population. Ranged between 4 to 9 (95% CI 7.07 to 7.85). (Table 5)

Table 6: Descriptive analysis of birth weight in study population (N=70)

Parameter	Mean ± SD	Median	Minimum	Maximum	95% C. I	
					Lower	Upper
Birth Weight	2.61 ± 0.68	2.70	0.96	4.20	2.45	2.77

The mean birth weight was 2.61 ± 0.68 in the study population. Ranged between 0.96 to 4.20 kg (95% CI 2.45 to 2.77). (Table 6)

Table 7: Descriptive analysis of small for gestational age in the study population (N=70)

Small for Gestational Age	Frequency	Percentages
Yes	14	20.0%
No	56	80.0%

Among the study population, 14 (20%) participants were small for gestational age. (Table 7 & Figure 2)

Figure 2: Bar chart of small for gestational age in the study population (N=70)

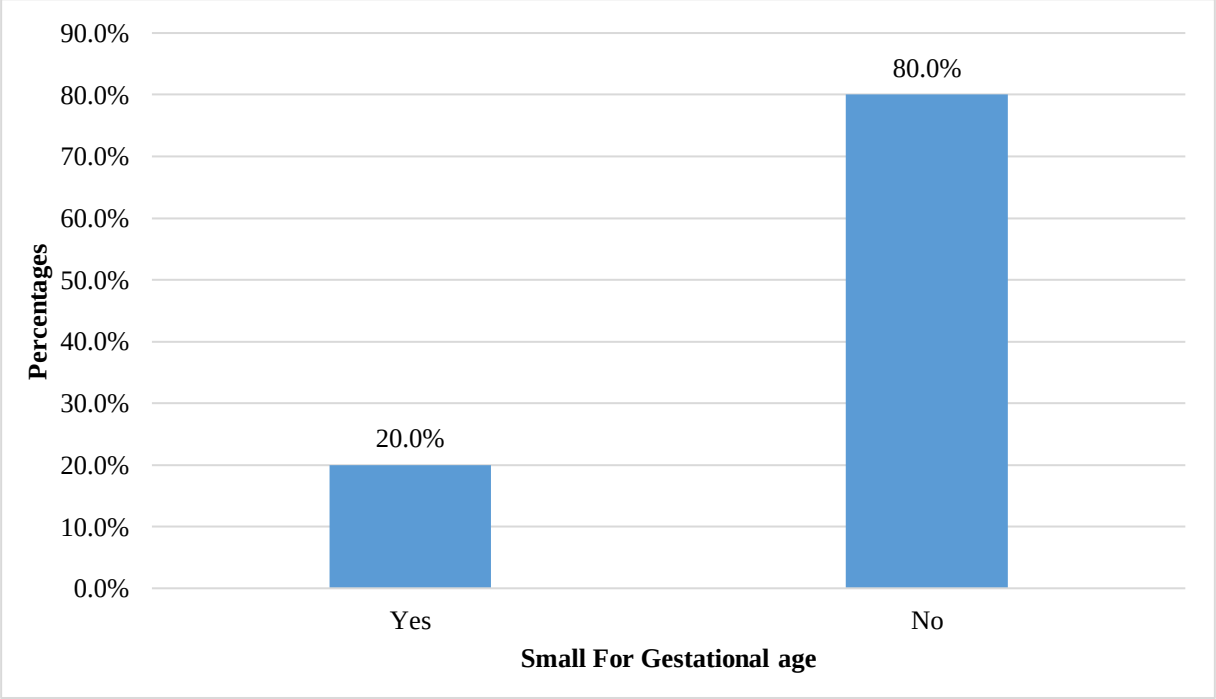

Table 8: Descriptive analysis of SNAP-PE II score in study population (N=70)

Parameter	Mean ± SD	Median	Minimum	Maximum	95% C.I	
					Lower	Upper
SNAP-PE II Score	23.34 ± 23.14	16.00	0.00	71.00	17.83	28.86

The mean SNAP-PE II Score was 23.34 ± 23.14 in the study population. Ranged between 0 to 71 (95% CI 17.83 to 28.86). (Table 8)

Table 9: Descriptive analysis of gestational age in study population (N=70)

Parameter	Mean ± SD	Median	Minimum	Maximum	95% C.I	
					Lower	Upper
Gestational Age (in weeks)	37.66 ± 2.53	38.00	32.00	42.00	37.06	38.27

The mean gestational age was 37.66 ± 2.53 weeks in the study population. Ranged between 32 to 42 weeks (95% CI 37.06 to 38.27). (Table 9)

Table 10: Descriptive analysis of congenital malformation in the study population (N=70)

Congenital Malformation	Frequency	Percentages
No	70	100%

Table 11: Descriptive analysis of parameters of SNAP-PE II in study population (N=70)

Parameter	Mean ± SD	Median	Minimum	Maximum	95% C. I	
					Lower	Upper
Max BE	-6.87 ± 5.17	-7.95	-24.00	12.40	-8.10	-5.64
Minimum Fio2	0.43 ± 0.19	0.40	0.20	0.80	0.38	0.47
Max Fio2	0.62 ± 0.24	0.60	0.00	1.00	0.57	0.68

The mean max BE was -6.87 ± 5.17 in the study population. Ranged between -24 to 12.40 (95% CI -8.10 to -5.64). The mean Minimum Fio2 was 0.43 ± 0.19 in the study population. Ranged

between 0.20 to 0.80 (95% CI 0.38 to 0.47). The mean Max Fio2 0.62 ± 0.24 in the study population. Ranged between was 0 to 1 (95% CI 0.57 to 0.68). (Table 11)

Table 12: Descriptive analysis of CRIB II in the study population (N=70)

Parameter	Mean ± SD	Median	Minimum	Maximum	95% C.I	
					Lower	Upper
CRIB II	3.6 ± 3.6	3.00	0.00	10.00	2.74	4.46

The mean CRIB II was 3.6 ± 3.6 in the study population. Ranged between 0 to 10 (95% CI 2.74 to 4.46). (Table 12)

Table 13: Descriptive analysis of SIRS in the study population (N=70)

SIRS	Frequency	Percentages
Yes	44	62.9%
No	26	37.1%

Among the study population, 44 (62.9%) participants had SIRS. (Table 13 & Figure 3)

Figure 3: Bar chart of SIRS in the study population (N=70)

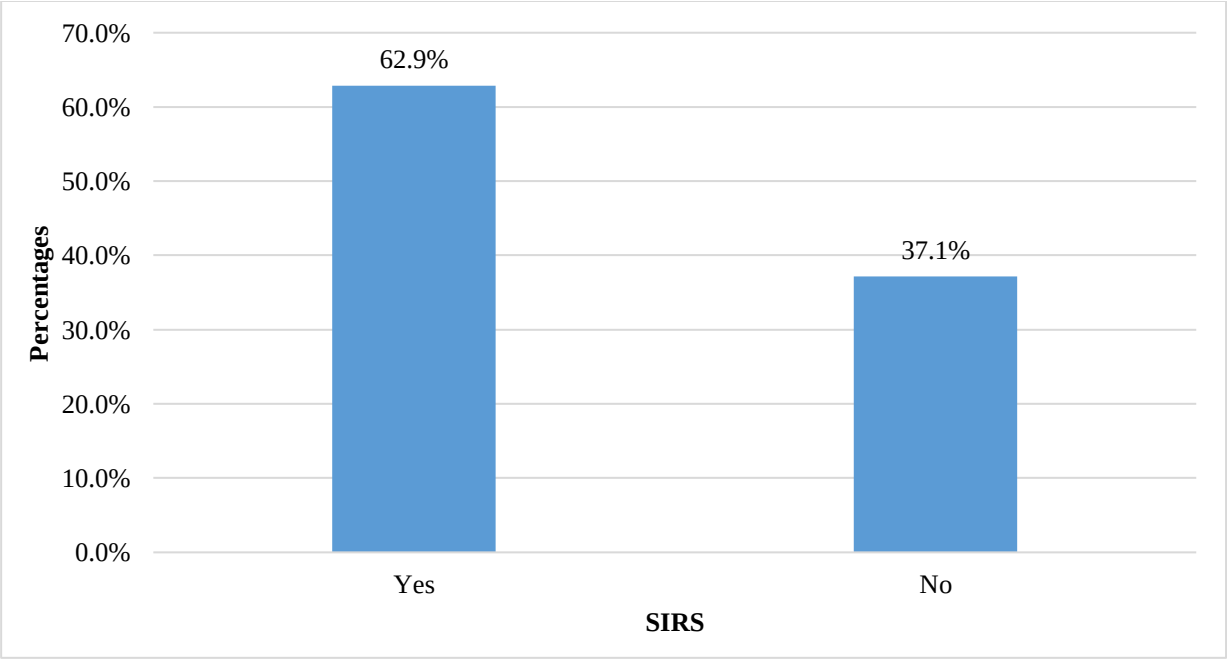

Table 14: Descriptive analysis of sepsis in the study population (N=70)

Sepsis	Frequency	Percentages
Yes	19	27.1%
No	51	72.9%

Among the study population, 19 (27.1%) participants had sepsis. (Table 14 & Figure 4)

Figure 4: Bar chart of sepsis in the study population (N=70)

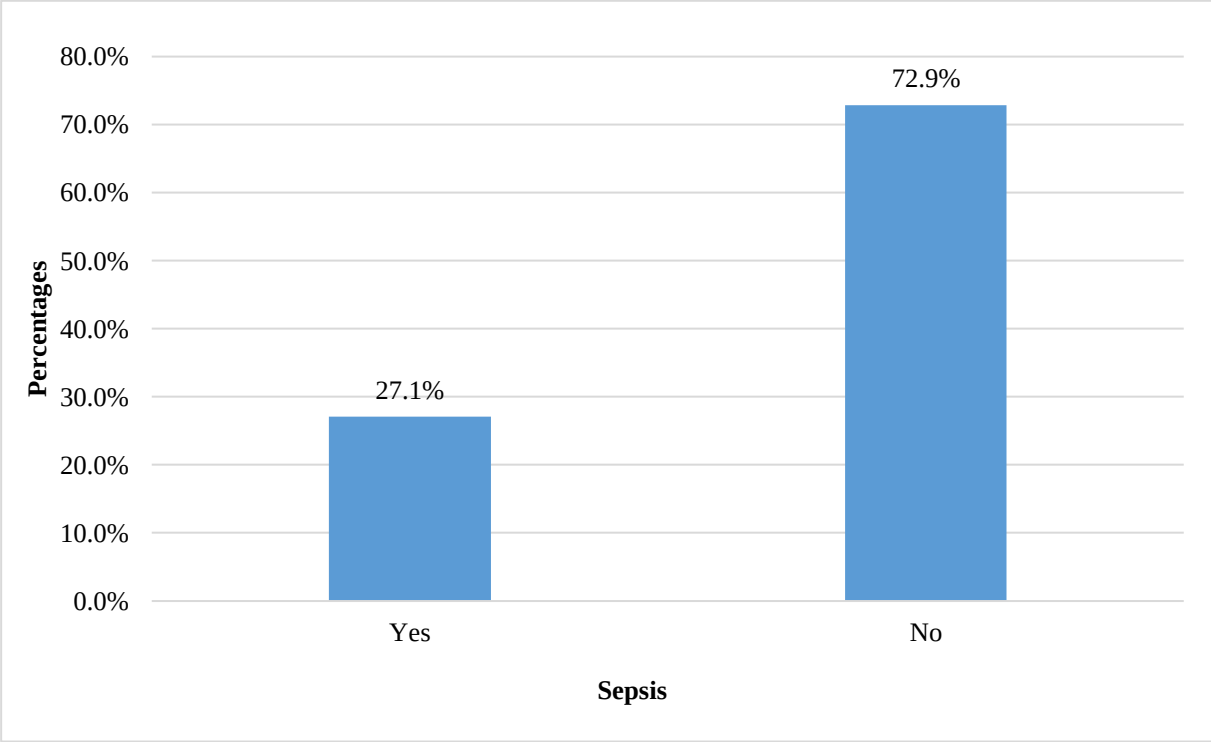

Table 15: Descriptive analysis of MODS in the study population (N=70)

MODS	Frequency	Percentages
Yes	8	11.4%
No	62	88.6%

Among the study population, 8 (11.4%) participants had MODS. (Table 15 & Figure 5)

Figure 5: Bar chart of MODS in the study population (N=70)

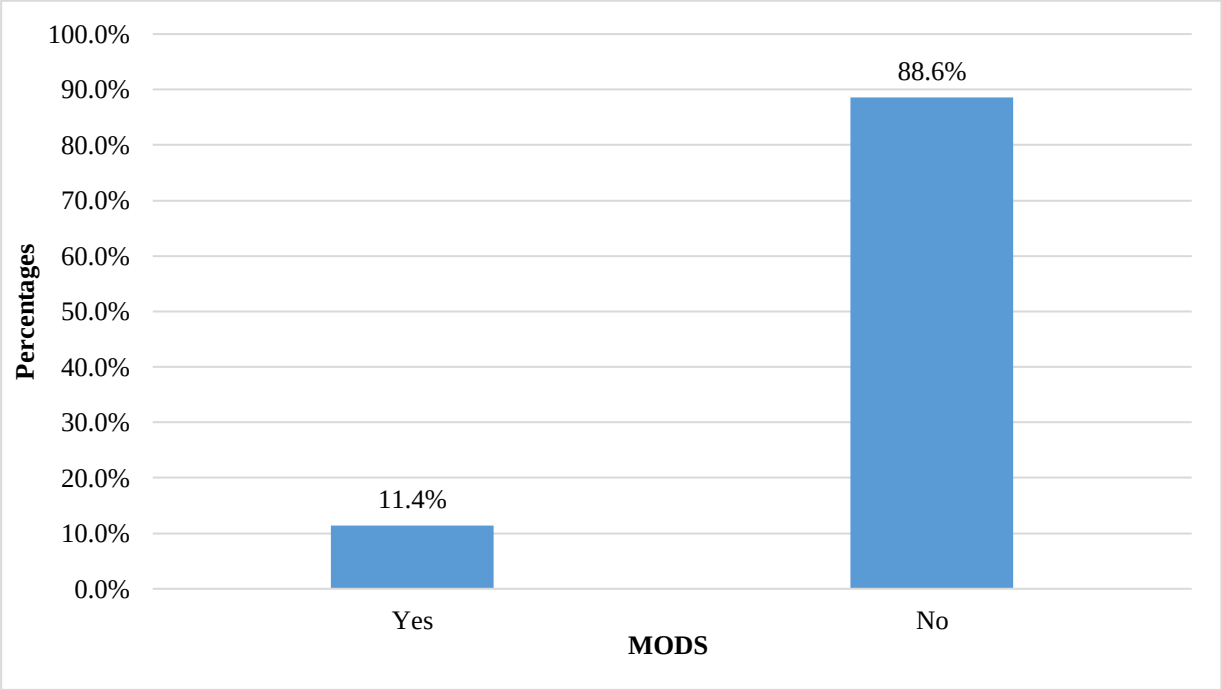

Table 16: Descriptive analysis of septic shock in the study population (N=70)

Septic Shock	Frequency	Percentages
Yes	13	18.6%
No	57	81.4%

Among the study population, 13 (18.6%) participants had septic shock. (Table 16 & Figure 6)

Figure 6: Bar chart of septic shock in the study population (N=70)

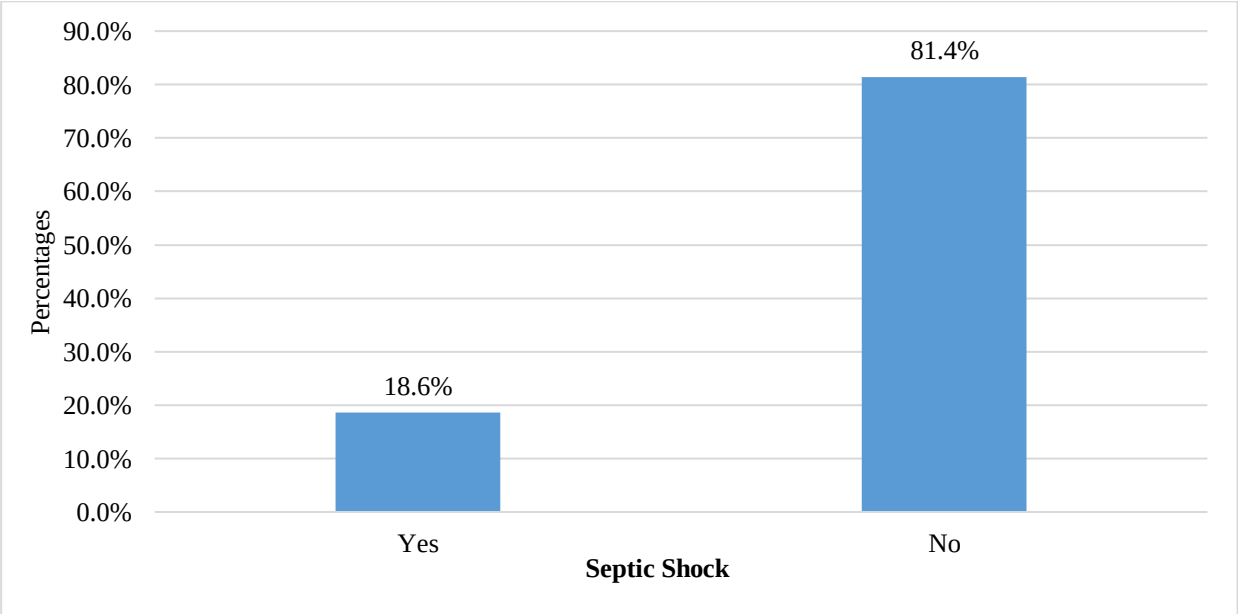

Table 17: Descriptive analysis of AKI in the study population (N=70)

AKI	Frequency	Percentages
Yes	31	44.3%
No	39	55.7%

Among the study population, 31 (44.3%) participants had AKI. (Table 17 & Figure 7)

Figure 7: Bar chart of AKI in the study population (N=70)

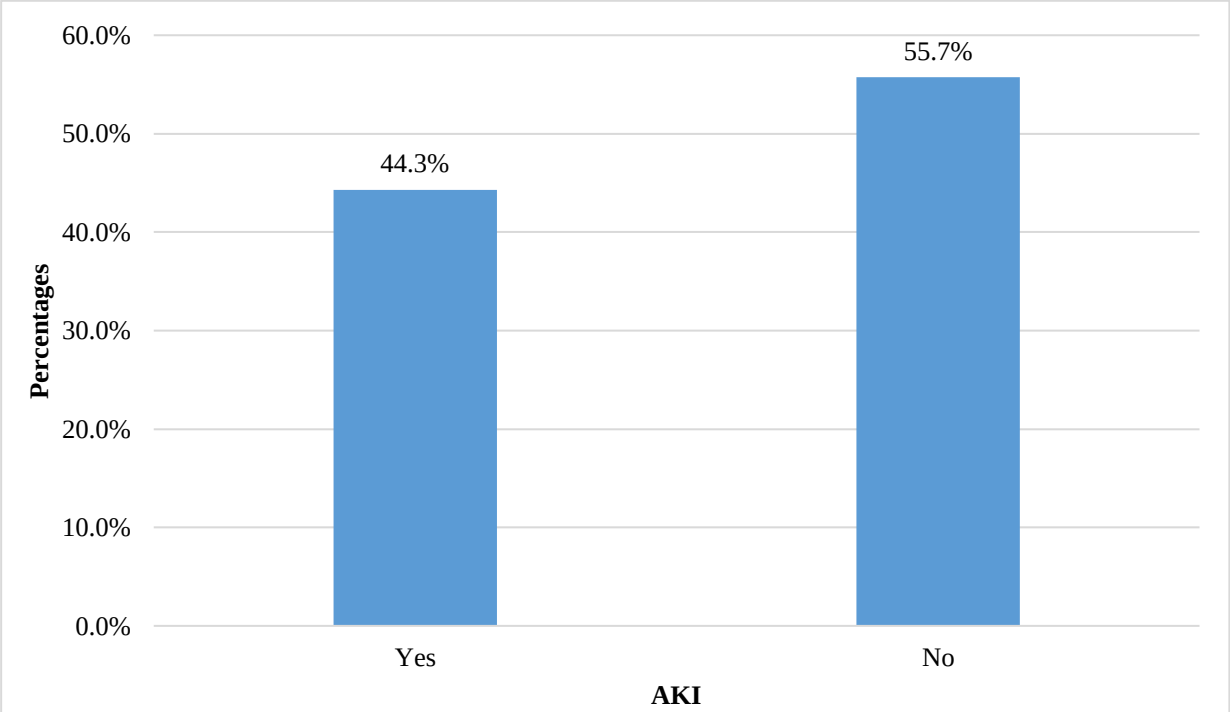

Table 18: Descriptive analysis of seizures in the study population (N=70)

Seizures	Frequency	Percentages
Yes	22	31.4%
No	48	68.6%

Among the study population, 22 (31.4%) participants had seizures. (Table 18 & Figure 8)

Figure 8: Bar chart of seizures in the study population (N=70)

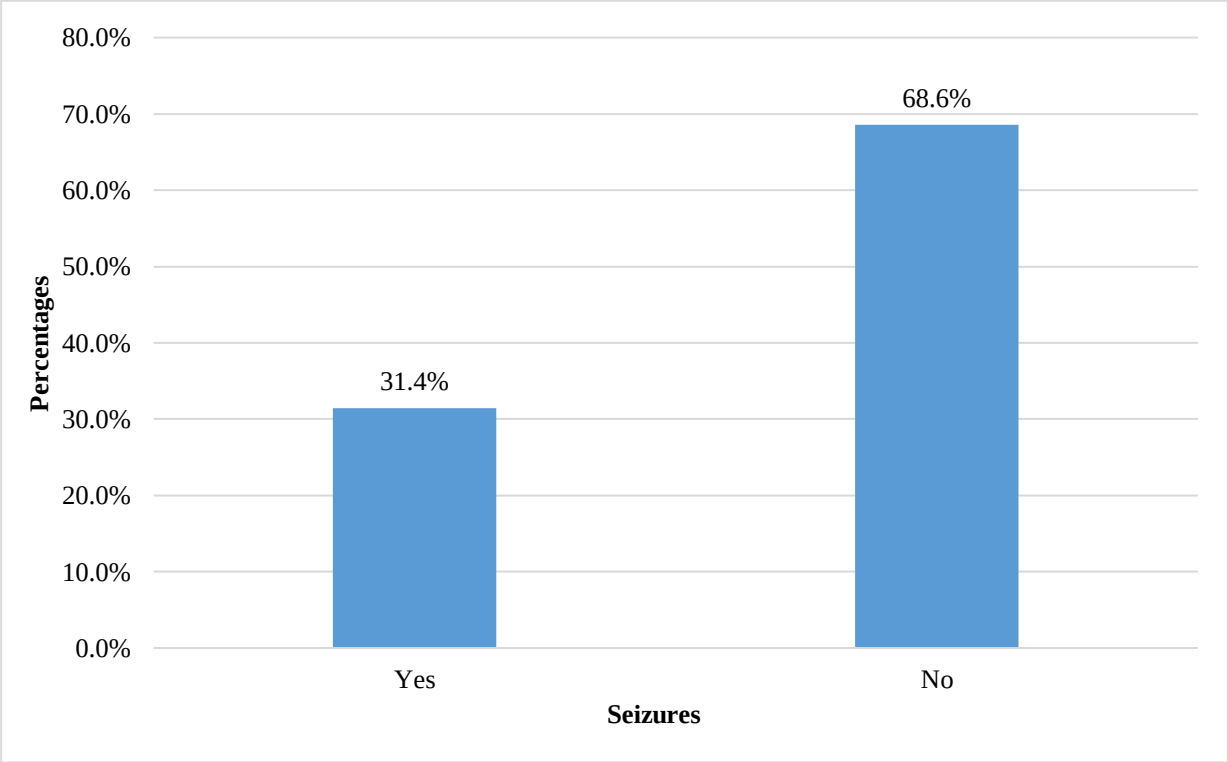

Table 19: Descriptive analysis of hypoglycemia in the study population (N=70)

Hypoglycemia	Frequency	Percentages
Yes	23	32.9%
No	47	67.1%

Among the study population, 23 (32.9%) participants had hypoglycemia. (Table 19 & Figure 9)

Figure 9: Bar chart of hypoglycemia in the study population (N=70)

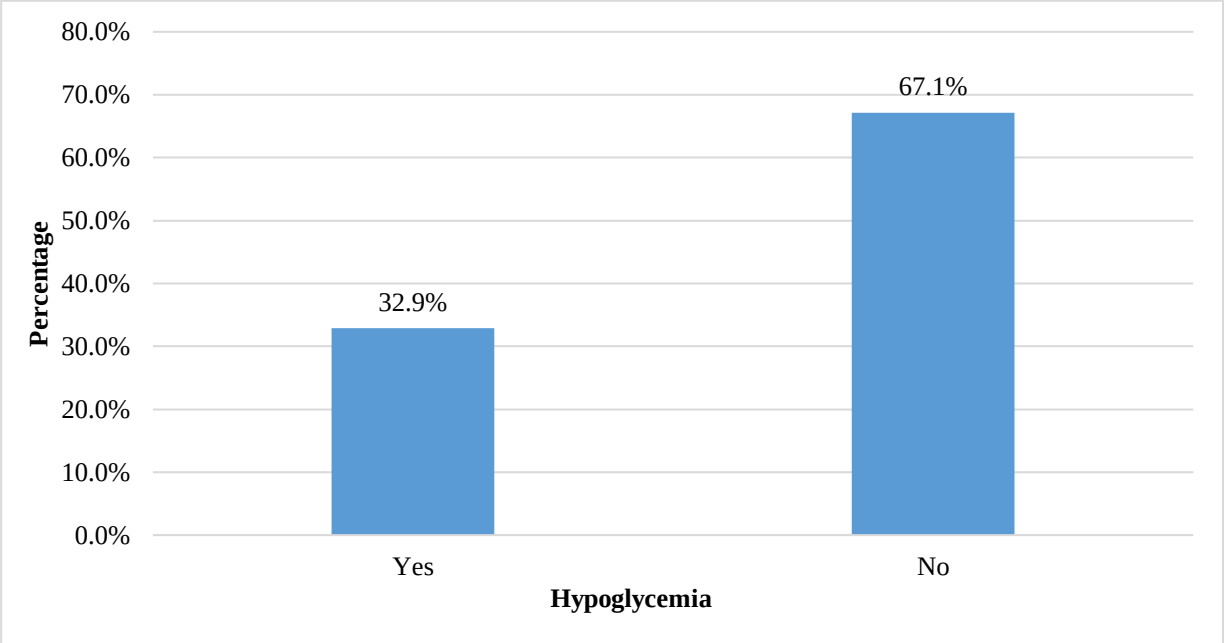

Table 20: Descriptive analysis of hyperbilirubinemia in the study population (N=70)

Hyperbilirubinemia	Frequency	Percentages
Yes	4	5.7%
No	66	94.3%

Among the study population, 4 (5.7%) participants had hyperbilirubinemia. (Table 20 & Figure 10)

Figure 10: Bar chart of hyperbilirubinemia in the study population (N=70)

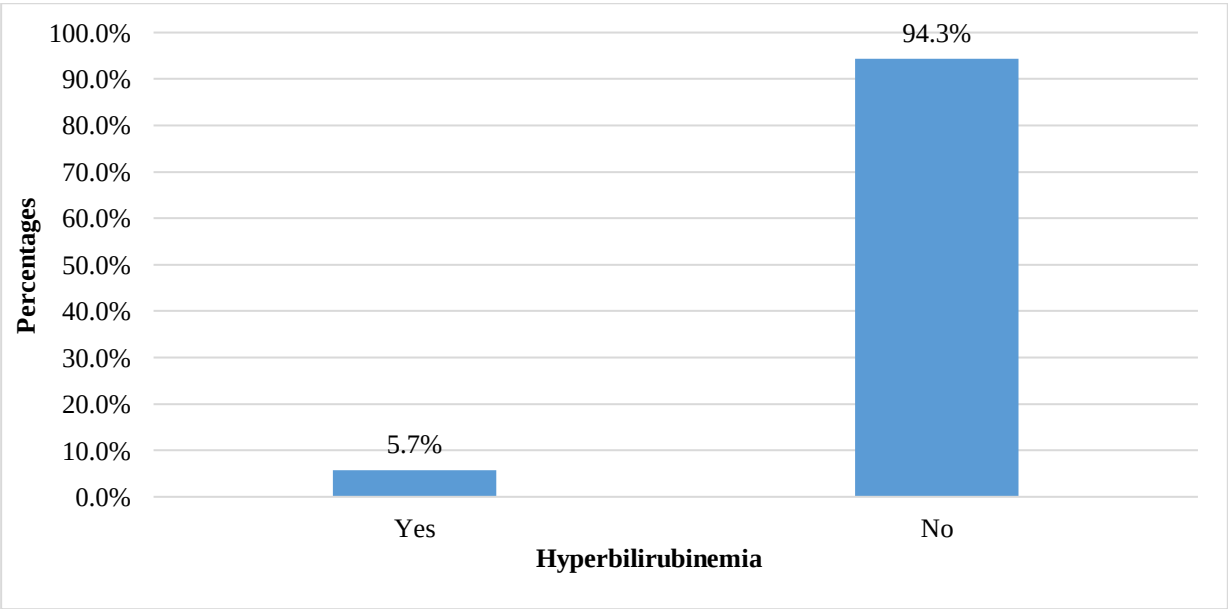

Table 21: Descriptive analysis of death in the study population (N=70)

Death	Frequency	Percentages
Yes	9	12.9%
No	61	87.1%

Among the study population, 9 (12.9%) participants were dead. (Table 21 & figure 11)

Figure 11: Bar chart of death in the study population (N=70)

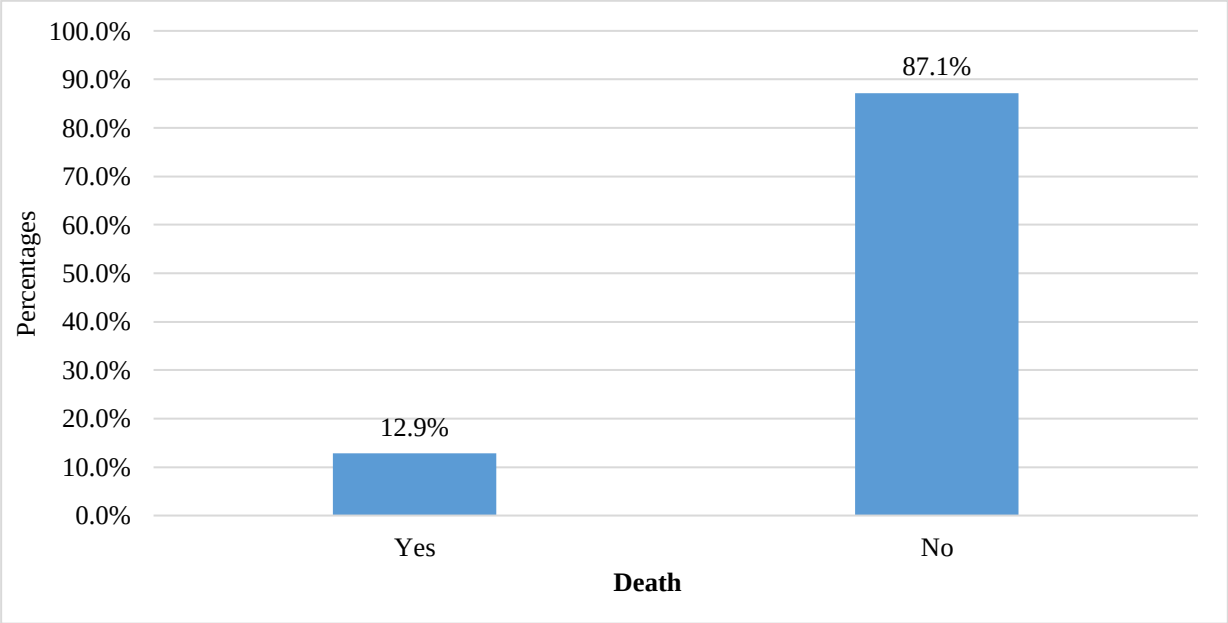

Table 22: Descriptive analysis of mean blood pressure category in the study population (N=70)

Mean Blood Pressure level	Frequency	Percentages
≥30 mm/hg	54	77.1%
20 to 29 mm/hg	15	21.4%
<20 mm/hg	1	1.4%

Among the neonates with blood pressure level, 54 (77.1%) participants had ≥30 mm/hg, 15 (21.4%) participants had 20 to 29 mm/hg and only 1 (1.4%) participant had <20 mm/hg. (Table 22)

Table 23: Descriptive analysis of temperature category in the study population (N=70)

Temperature level	Frequency	Percentages
>96	54	77.1%
95 to 96 F	16	22.9%

Among the neonates with temperature level, 54 (77.1%) participants had >96 F, and 16 (22.9%) participants had 95 to 96 F. (Table 23)

Table 24: Descriptive analysis of po2 level in the study population (N=70)

Po2 level	Frequency	Percentages
>2.49	35	50.0%
1 to 2.49	25	35.7%
0.3 to 0.99	10	14.3%

Among the neonates with po2 level, 35 (50%) participants had >2.49, 25 (35.7%) participants had 1 to 2.49 and 10 (14.3%) participant had 0.3 to 0.99. (Table 24)

Table 25: Descriptive analysis of PH category in the study population (N=70)

PH Category	Frequency	Percentages
≥7.20	53	75.7%
7.10 to 7.19	17	24.3%

Among the neonates with PH level, 53 (75.7%) participants had ≥7.20 and 17 (24.3%) participants had 7.10 to 7.19. (Table 25)

Table 26: Descriptive analysis of urine output category in the study population (N=70)

Urine output Category	Frequency	Percentages
≥1 ml/kg	58	82.9%
0.1 to 0.9 ml/kg	12	17.1%

Among the neonates with urine output level, 58 (82.9%) participants had ≥1 ml/kg and 12 (17.1%) participants had 0.1 to 0.90 ml/kg. (Table 26)

Table 27: Descriptive analysis of APGAR score in the study population (N=70)

APGAR Score	Frequency	Percentages
≥7	54	77.1%
<7	16	22.9%

Among the neonates with APGAR score, 54 (77.1%) participants had ≥7, and 16 (22.9%) participants had <7. (Table 27)

Table 28: Descriptive analysis of birth weight category in the study population (N=70)

Birth Weight Category	Frequency	Percentages
≥1 kg	69	98.6%
0.75 to 0.99 kg	1	1.4%

Among the study population, 69 (98.6%) neonates had ≥1 kg, and only 1 (1.4%) child had 0.75 to 0.99 kg. (Table 28)

Table 29: Descriptive analysis of birth weight category in the study population (N=70)

Birth weight category	Frequency	Percentages
≥1.35kg	68	97.1%
0.85 to 1.34 kg	2	2.9%

Among the study population, 68 (97.1%) neonates had ≥1.35 kg, and 2 (2.9%) neonates had 0.85 to 1.34 kg. (Table 29)

Table 30: Descriptive analysis of max BE a category in the study population (N=70)

Max BE Category	Frequency	Percentages
>-7	28	40.0%
-7 to -9.9	31	44.3%
-10 to -14.9	9	12.9%
≤-15	2	2.9%

Among the neonates with max BE, 28 (40%) participants had >-7, 31 (44.3%) participants had -7 to -9.9, 9 (12.9%) participants had -10 to 14.9 and 2 (2.9%) participants had ≤ -15 max BE. (Table 30)

Table 31: Comparison of CRIBI II, SNAP PEII between sepsis (N=70)

Parameter	Sepsis Median (IQR)		Mann Whitney U test (P value)
	Yes (N=19)	No (N=51)	
CRIB II (N=70)	5 (0,10)	2 (0,6)	0.162
SNAP-PE II score (N=70)	23 (0,54)	13 (0,42)	0.401

Among the neonates with sepsis, the median CRIB II was 5(IQR 0 to 10), and it was 2 (IQR 0 to 6) in neonates without sepsis. The difference in the CRIB II between neonates with and without sepsis group was statistically not significant (P Value 0.162). Among the neonates with sepsis, the median SNAP-PE II score was 23 (IQR 0 to 54) and it was 13 (IQR 0 to 42) in neonates without sepsis. The difference in the SNAP-PE II score between neonates with and without sepsis group was statistically not significant (P Value 0.401). (Table 31)

Table 32: Comparison of CRIBI II, SNAP PEII between AKI (N=70)

Parameter	AKI Median (IQR)		Mann Whitney U test (P value)
	Yes (N=31)	No(N=39)	
CRIB II	8 (6,8)	0 (0,2)	<0.001
SNAP-PE II score	45 (41,54)	0 (0,5)	<0.001

Among the neonates with AKI, the median CRIB II was 8 (IQR 6 to 8), and it was 0 (IQR 0 to 2) in neonates without AKI. The difference in the CRIB II between neonates with and without AKI group was statistically significant (P Value <0.001). Among the neonates with AKI, the median SNAP-PE II score was 45 (IQR 41 to 54) and it was 0 (IQR 0 to 5) in neonates without AKI. The difference in the SNAP-PE II score between neonates with and without AKI group was statistically significant (P Value <0.001). (Table 32)

Table 33: Comparison of CRIBI II, SNAP PEII between Seizures (N=70)

Parameter	Seizures Median (IQR)		Mann Whitney U test (P value)
	Yes (N=22)	No(N=48)	
CRIB II	4 (1.75,6)	1 (0,8)	0.728
SNAP-PE II score	34 (5,49)	6.5 (0,42)	0.058

Among the neonates with Seizures, the median CRIB II was 4 (IQR 1.75 to 6), and it was 1 (IQR 0 to 8) in neonates without Seizures. The difference in the CRIB II between neonates with and without Seizures group was statistically not significant (P Value 0.728). Among the neonates with Seizures, the median SNAP-PE II score was 34 (IQR 5 to 49) and it was 6.5 (IQR 0 to 42) in neonates without Seizures. The difference in the SNAP-PE II score between neonates with and without Seizures group was statistically not significant (P Value 0.058). (Table 33)

Table 34: Comparison of CRIBI II, SNAP PEII between Hypoglycemia (N=70)

Parameter	Hypo glycaemia Median (IQR)		Mann Whitney U test (P value)
	Yes (N=23)	No(N=47)	
CRIB II	4 (0,8)	2 (0,6)	0.196
SNAP-PE II score	42 (0,42)	5 (0,48)	0.231

Among the neonates with hypoglycemia, the median CRIB II was 4 (IQR 0 to 8), and it was 2 (IQR 0 to 6) in neonates without hypoglycemia. The difference in the CRIB II between neonates with and without hypoglycemia group was statistically not significant (P Value 0.196). Among the neonates with hypoglycemia, the median SNAP-PE II score was 42 (IQR 0 to 42) and it was 5 (IQR 0 to 48) in neonates without hypoglycemia. The difference in the SNAP-PE II score between neonates with and without hypoglycemia group was statistically not significant (P Value 0.123). (Table 34)

Table 35: Comparison of CRIBI II, SNAP PEII between hyperbilirubinemia (N=70)

Parameter	Hyperbilirubinemia Median (IQR)		Mann Whitney U test (P value)
	Yes (N=4)	No(N=66)	
CRIB II	0 (0,1.5)	4 (0,8)	0.083
SNAP-PE II score	0 (0,16.5)	20.5 (0,45.75)	0.089

Among the neonates with hyperbilirubinemia, the median CRIB II was 0 (IQR 0 to 1.5), and it was 4 (IQR 0 to 8) in neonates without hyperbilirubinemia. The difference in the CRIB II between neonates with and without hyperbilirubinemia group was statistically not significant (P Value 0.083). Among the neonates with hyperbilirubinemia, the median SNAP-PE II score was 0 (IQR 0 to 16.5) and it was 20.5 (IQR 0 to 45.75) in neonates without hyperbilirubinemia. The difference in the SNAP-PE II score between neonates with and without hyperbilirubinemia group was statistically not significant (P Value 0.089). (Table 35)

Table 36: Comparison of CRIBI II, SNAP PEII between death (N=70)

Parameter	Death Median (IQR)		Mann Whitney U test (P value)
	Yes (N=9)	No(N=61)	
CRIB II	8 (8,10)	2 (0,6)	<0.001
SNAP-PE II score	58 (41,58)	8 (0,42)	<0.001

Among the neonates who had dead, the median CRIB II was 8 (IQR 8 to 10). The difference in the CRIB II between death was statistically significant (P Value <0.001). Among the neonates who had dead, the median SNAP-PE II score was 58 (IQR 41 to 58). The difference in the SNAP-PE II score between dead was statistically significant (P Value <0.001). (Table 36)

Table 37: Comparison of parameters of CRIB and SNAP-PE II scores between hyperbilirubinemia (N=70)

Parameter	Hyperbilirubinemia	Chi square	P value

	Yes	No		
Mean Blood Pressure				
>= 30 Mm/hg (N=54)	4 (7.41%)	50 (92.59%)	*	*
20 To 29 Mm/hg (N=15)	0 (0%)	15 (100%)		
<20 Mm/hg (N=1)	0 (0%)	1 (100%)		
Temperature				
>96 (N=54)	4 (7.41%)	50 (92.59%)	*	*
95 To 96 F (N=16)	0 (0%)	16 (100%)		
Po2				
>2.49 (N=35)	3 (8.57%)	32 (91.43%)	*	*
1 To 2.49 (N=25)	1 (4%)	24 (96%)		
0.3 To 0.99 (N=10)	0 (0%)	10 (100%)		
PH				
≥7.20 (N=53)	4 (7.55%)	49 (92.45%)	*	*
7.10 To 7.19 (N=17)	0 (0%)	17 (100%)		
Seizures				
Yes (N=22)	0 (0%)	22 (100%)	*	*
No (N=48)	4 (8.33%)	44 (91.67%)		
Urine output				
>=1 ml/kg (N=58)	3 (5.17%)	55 (94.83%)	*	0.537
0.1 To 0.9 ml/kg (N=12)	1 (8.33%)	11 (91.67%)		
APGAR Score				
>=7 (N=54)	4 (7.41%)	50 (92.59%)	*	*
<7 (N=16)	0 (0%)	16 (100%)		
Birthweight				
>=1.35Kg (N=68)	4 (5.88%)	64 (94.12%)	*	*
0.85 To 1.34 Kg (N=2)	0 (0%)	2 (100%)		
Max BE				
>-7 (N=28)	3 (10.71%)	25 (89.29%)	*	*
-7 To -9.9 (N=31)	1 (3.23%)	30 (96.77%)		
-10 To -14.9 (N=9)	0 (0%)	9 (100%)		
<=-15 (N=2)	0 (0%)	2 (100%)		
Minimum Fio2				
≤0.40 (N=37)	4 (10.81%)	33 (89.19%)	*	*

0.41 To 0.60 (N=21)	0 (0%)	21 (100%)		
0.61 To 0.90 (N=12)	0 (0%)	12 (100%)		
Maximum Fio2				
<=0.40 (N=29)	3 (10.34%)	26 (89.66%)	*	*
0.41 To 0.60 (N=9)	1 (11.11%)	8 (88.89%)		
0.61 To 0.90 (N=27)	0 (0%)	27 (100%)		
0.91 To 1 (N=5)	0 (0%)	5 (100%)		
SGA				
Yes (N=14)	1 (7.14%)	13 (92.86%)	*	1.00
No (N=56)	3 (5.36%)	53 (94.64%)		
Gestational age (Mean± SD)	36.75 ± 2.99	37.72 ± 2.52	-0.738	0.463

**No statistical test was applied- due to 0 subjects in the cells*

Out of 54 Neonates with mean blood pressure ≥30 Mm/hg, 4 (7.41%) had hyperbilirubinemia. Out of 54 Neonates with temperature >96 F, 4 (7.41%) had hyperbilirubinemia. Out of 35 Neonates with >2.49 po2 level, 3 (8.57%) had hyperbilirubinemia. Out of 17 Neonates with 1 to 2.49 po2 level, 1 (4%) had hyperbilirubinemia. Out of 53 Neonates with ≥7.20 PH level, 4 (7.55%) had hyperbilirubinemia. Out of 58 Neonates who had ≥1 ml/kg urine output, 3 (5.17%) had hyperbilirubinemia. Out of 54 Neonates with had ≥7 APGAR score, 4 (7.41%) had hyperbilirubinemia. Out of 68 neonates had ≥1.35Kg, 4 (5.8%) had hyperbilirubinemia. Out of 28 neonates with max BE >-7, 3 (10.71%) had hyperbilirubinemia. Out of 31 neonates with max BE -7 to -9.9, 1 (3.23%) had hyperbilirubinemia. Out of 37 neonates with Fio2 ≤0.40, 4 (10.81%) had hyperbilirubinemia. Out of 29 neonates with maximum fio2 ≤0.40, 3 (10.34%) participants had hyperbilirubinemia. There was no statistically significant difference in hyperbilirubinemia between SGA with P value of 1.00. The mean gestational age in Neonates with hyperbilirubinemia was 38.05 ± 1.59 weeks, it was 37.49 ± 2.86 weeks in Neonates without hyperbilirubinemia. The difference in gestational age between hyperbilirubinemia was statistically not significant. (p value 0.463). (Table 37)

Table 38: Comparison of parameters of CRIB and SNAP-PE II scores between death (N=70)

Parameter	Death		Chi square / t value	P value
	Yes	No		
Mean Blood Pressure				
>= 30 Mm/hg (N=54)	1 (1.85%)	53 (98.15%)	*	*
20 To 29 Mm/hg (N=15)	7 (46.67%)	8 (53.33%)		
<20 Mm/hg (N=1)	1 (100%)	0 (0%)		
Temperature				
>96 (N=54)	3 (5.56%)	51 (94.44%)	*	0.003
95 To 96 F (N=16)	6 (37.5%)	10 (62.5%)		
Po2				
>2.49 (N=35)	1 (2.86%)	34 (97.14%)	23.486	<0.001
1 To 2.49 (N=25)	2 (8%)	23 (92%)		
0.3 To 0.99 (N=10)	6 (60%)	4 (40%)		
PH				
>=7.20 (N=53)	1 (1.89%)	52 (98.11%)	*	<0.001
7.10 To 7.19 (N=17)	8 (47.06%)	9 (52.94%)		
Seizures				
Yes (N=22)	2 (9.09%)	20 (90.91%)	*	0.709
No (N=48)	7 (14.58%)	41 (85.42%)		
Urine output Category				
>=1 kg/ml(N=58)	5 (8.62%)	53 (91.38%)	5.420	0.041
0.1 to 0.9 kg/ml (N=12)	4 (33.33%)	8 (66.67%)		
APGAR Score				
>=7 (N=54)	7 (12.96%)	47 (87.04%)	*	1.000
<7 (N=16)	2 (12.5%)	14 (87.5%)		
Birth weight				
>=1.35Kg (N=68)	9 (13.24%)	59 (86.76%)	*	*
0.85 To 1.34 Kg (N=2)	0 (0%)	2 (100%)		
Max BE				
>-7 (N=28)	0 (0%)	28 (100%)	*	*
-7 To -9.9 (N=31)	2 (6.45%)	29 (93.55%)		

-10 To -14.9 (N=9)	7 (77.78%)	2 (22.22%)		
<=-15 (N=2)	0 (0%)	2 (100%)		
Minimum Fio2				
<=0.40 (N=37)	0 (0%)	37 (100%)	*	*
0.41 To 0.60 (N=21)	1 (4.76%)	20 (95.24%)		
0.61 To 0.90 (N=12)	8 (66.67%)	4 (33.33%)		
Maximum Fio2				
<=0.40 (N=29)	0 (0%)	29 (100%)	*	*
0.41 To 0.60 (N=9)	1 (11.11%)	8 (88.89%)		
0.61 To 0.90 (N=27)	5 (18.52%)	22 (81.48%)		
0.91 To 1 (N=5)	3 (60%)	2 (40%)		
SGA				
Yes (N=14)	0 (0%)	14 (100%)	*	*
No (N=56)	9 (16.07%)	47 (83.93%)		
Gestational age (Mean± SD)	39.07 ± 1.27	37.45 ± 2.61	1.812	0.074

**No statistical test was applied- due to 0 subjects in the cells*

Out of 54 neonates with mean blood pressure ≥30 Mm/hg, only one (1.85%) participant were dead. Out of 15 neonates with 20 to 29 mm, hg mean BP 7 (46.67%) were dead. Out of 1 child with <20 mm hg 1 (100%) was dead. The difference in death between the temperature is found to be significant with a P- value of 0.003. The difference in death between the po2 level is found to be significant with a P- value of <0.001. The difference in death between the PH level is found to be significant with a P- value of <0.001. The difference in death between the Seizures is found to be insignificant with a P- value of 0.709. The difference in death between the Urine output is found to be significant with a P- value of 0.041. The difference in death between the APGAR score is found to be insignificant with a P- value of 1.000. Out of 68 neonates with ≥1.35 kg birth weight, 9 (13.24%) participants were dead. Out of 31 neonates with max BE -7 to -9.9, 2 (6.45%) participants were dead. Out of 91 neonates had max BE -10 to -14.9, 7 (77.78%) neonates were dead. Out of 21 neonates with minimum fio2 0.41 to 0.60, only 1 (4.76%) was dead. Out of 12 neonates with minimum fio2 0.61 to 0.90, 8 (66.67%) were dead.

Out of 9 neonates with maximum fio2 0.41 to 0.60, only 1 (11.11%) was dead. Out of 27 neonates with minimum fio2 0.61 to 0.90, 5 (18.52%) participants were dead. Out of 27 neonates with minimum fio2 0.91 to 1, 3 (60%) participants were dead. The mean gestational age in the death group was 39.07 ± 1.27 years, it was 37.45 ± 2.61 in no death group. The difference in gestational age between death was statistically not significant. (P value 0.074). (Table 38)

Table 39: Comparison of parameters of CRIB and SNAP-PE II scores between SIRS (N=70)

Parameter	SIRS		Chi square /t value	P value
	Yes	No		
Gestational age (Mean± SD)	36.93 ± 2.78	38.89 ± 1.39	-3.34	0.001
Max BE				
>-7 (N=28)	11 (39.29%)	17 (60.71%)	*	*
-7 To -9.9 (N=31)	25 (80.65%)	6 (19.35%)		
-10 To -14.9 (N=9)	8 (88.89%)	1 (11.11%)		
<=-15 (N=2)	0 (0%)	2 (100%)		
Minimum Fio2				
<=0.40 (N=37)	13 (35.14%)	24 (64.86%)	*	*
0.41 To 0.60 (N=21)	19 (90.48%)	2 (9.52%)		
0.61 To 0.90 (N=12)	12 (100%)	0 (0%)		
Maximum Fio2				
<=0.40 (N=29)	10 (34.48%)	19 (65.52%)	*	*
0.41 To 0.60 (N=9)	4 (44.44%)	5 (55.56%)		
0.61 To 0.90 (N=27)	25 (92.59%)	2 (7.41%)		
0.91 To 1 (N=5)	5 (100%)	0 (0%)		
Mean Blood Pressure				
>= 30 MMHG (N=54)	28 (51.85%)	26 (48.15%)	*	*
20 To 29 MMHG (N=15)	15 (100%)	0 (0%)		

<20 MMHG (N=1)	1 (100%)	0 (0%)		
Temperature				
>96 (N=54)	29 (53.7%)	25 (46.3%)	*	0.003
95 To 96 F (N=16)	15 (93.75%)	1 (6.25%)		
PO2				
>2.49 (N=35)	15 (42.86%)	20 (57.14%)	12.299	0.002
1 To 2.49 (N=25)	20 (80%)	5 (20%)		
0.3 To 0.99 (N=10)	9 (90%)	1 (10%)		
PH				
>=7.20 (N=53)	28 (52.83%)	25 (47.17%)	*	0.003
7.10 To 7.19 (N=17)	16 (94.12%)	1 (5.88%)		
Urine output				
>=1 kg/ml (N=58)	32 (55.17%)	26 (44.83%)	*	*
0.1 To 0.9 Kg/ml (N=12)	12 (100%)	0 (0%)		
APGAR Score				
>=7 (N=54)	29 (53.7%)	25 (46.3%)	*	0.003
<7 (N=16)	15 (93.75%)	1 (6.25%)		
Birth weight				
>=1.35Kg (N=68)	42 (61.76%)	26 (38.24%)	*	*
0.85 To 1.34 Kg (N=2)	2 (100%)	0 (0%)		
Seizures				
Yes (N=22)	14 (63.64%)	8 (36.36%)	0.008	0.927
No (N=48)	30 (62.5%)	18 (37.5%)		
SGA				
Yes (N=14)	14 (100%)	0 (0%)	*	*
No (N=56)	30 (53.57%)	26 (46.43%)		

**No statistical test was applied- due to 0 subjects in the cells*

The mean gestational age in neonates with SIRS was 36.93 ± 2.78 weeks, it was 38.89 ± 1.39 weeks in neonates without SIRS. The difference in gestational age between SIRS was

statistically significant. (p value 0.001). Out of 28 participants with >-7 max BE 11 (39.29%) has SIRS, among neonates with -7 to -9.9 max BE 25 (80.65%) had SIRS, among neonates with -10 to -14.9 max BE 8 (88.89%) had SIRS. Among neonates with <=0.40 minimum fio2 13 (35.14%) had SIRS, among neonates with 0.41 to 0.60 minimum fio2 19 (90.48%) had SIRS, and among neonates with 0.61 to 0.90 minimum fio2, 12 (100%) had SIRS. Among the neonates with <=0.40 maximum fio2, 10 (34.48%) had SIRS, among neonates with 0.41 to 0.60 maximum fio2,4 (44.44%) had SIRS, among neonates with 0.61 to 0.90 maximum fio2, 25 (92.59%) had SIRS and among neonates with 0.91 to 1 maximum fio2, 5 (100%) had SIRS. Among the neonates with >= 30 mm hg mean BP 28 (51.85%) had SIRS, among neonates with 20 to 29 mm hg BP 15 (100%) had SIRS and among neonates, with <20 mm hg BP only one participant had sepsis. There was a statistically significant difference in SIRS between temperature with p value 0.003. There was a statistically significant difference in SIRS across po2 with p value 0.002 majority of 20 (80%) neonates had 1 to 2.49 po2 with SIRS. Among neonates with >=7.20 Ph 28 (52.83%) had SIRS and among neonates with 7.10 to 7.19 Ph 16 (94.12%) had SIRS. The difference in the proportion of SIRS between Ph was statistically significant. (p value 0.003). Among neonates with >=1 kg/ml urine output 32 (55.17%) had SIRS and among neonates with 0.1 to 0.9 kg/ml urine output 12 (100%) had SIRS. There was a statistically significant difference in SIRS between APGAR score with a p value of 0.003 majority of 29 (53.7%) had >=7 APGAR score with SIRS. Among neonates with birth weight >= 1.35 birth weight 42 (61.76%) had SIRS and among neonates with 0.85 to 1.34 kg birth weight 2 (100%) had SIRS. The difference in the proportion of SIRS between seizures was statistically not significant. (p value 0.927). Among the neonates with SGA 14 (100%) had SIRS. (Table 39)

Table 40: Comparison of parameters of CRIB and SNAP-PE II scores between sepsis (N=70)

Parameter	Sepsis		Chi square/ t value	P value
	Yes	No		
Gestational age (Mean± SD)	37.46 ± 2.35	37.74 ± 2.62	-0.397	0.693
Max BE				
>-7 (N=28)	7 (25%)	21 (75%)	*	*
-7 To -9.9 (N=31)	8 (25.81%)	23 (74.19%)		
-10 To -14.9 (N=9)	4 (44.44%)	5 (55.56%)		
<=-15 (N=2)	0 (0%)	2 (100%)		
Minimum Fio2				
<=0.40 (N=37)	9 (24.32%)	28 (75.68%)	7.807	0.020
0.41 To 0.60 (N=21)	3 (14.29%)	18 (85.71%)		
0.61 To 0.90 (N=12)	7 (58.33%)	5 (41.67%)		
Maximum Fio2				
<=0.40 (N=29)	6 (20.69%)	23 (79.31%)	*	*
0.41 To 0.60 (N=9)	3 (33.33%)	6 (66.67%)		
0.61 To 0.90 (N=27)	5 (18.52%)	22 (81.48%)		
0.91 To 1 (N=5)	5 (100%)	0 (0%)		
Mean Blood Pressure				
>= 30 MMHG (N=54)	14 (25.93%)	40 (74.07%)	*	*
20 To 29 MMHG (N=15)	5 (33.33%)	10 (66.67%)		
<20 MMHG (N=1)	0 (0%)	1 (100%)		
Temperature				
>96 (N=54)	15 (27.78%)	39 (72.22%)	*	1.000
95 To 96 F (N=16)	4 (25%)	12 (75%)		
PO2				
>2.49 (N=35)	8 (22.86%)	27 (77.14%)	3.092	0.213
1 To 2.49 (N=25)	6 (24%)	19 (76%)		

0.3 To 0.99 (N=10)	5 (50%)	5 (50%)		
PH				
>=7.20 (N=53)	11 (20.75%)	42 (79.25%)	4.503	0.034
7.10 To 7.19 (N=17)	8 (47.06%)	9 (52.94%)		
Urine output				
>=1 kg/ml (N=58)	11 (18.97%)	47 (81.03%)	*	0.002
0.1 To 0.9 Kg/ml (N=12)	8 (66.67%)	4 (33.33%)		
APGAR Score				
>=7 (N=54)	14 (25.93%)	40 (74.07%)	*	0.752
<7 (N=16)	5 (31.25%)	11 (68.75%)		
Birth weight				
>=1.35Kg (N=68)	18 (26.47%)	50 (73.53%)	*	0.472
0.85 To 1.34 Kg (N=2)	1 (50%)	1 (50%)		
Seizures				
Yes (N=22)	3 (13.64%)	19 (86.36%)	*	0.146
No (N=48)	16 (33.33%)	32 (66.67%)		
SGA				
Yes (N=14)	3 (21.43%)	11 (78.57%)	*	0.744
No (N=56)	16 (28.57%)	40 (71.43%)		

The mean gestational age in neonates with sepsis was 37.46 ± 2.35 weeks, it was 37.74 ± 2.62 weeks in neonates without sepsis. The difference in gestational age between sepsis was statistically not significant. (P value 0.693). Out of 28 neonates with >-7 max BE 7 (25%) has sepsis, among neonates with -7 to -9.9 max BE 8 (25.81%) had sepsis. Out of 37 neonates with -10 to -14.9 max BE 4 (44.44%) had sepsis. There was a statistically significant difference in minimum FIO2 between sepsis with P value 0.020. Out of 29 neonates with ≤0.40 maximum FIO2 6 (20.69%) has sepsis. Out of 29 neonates with 0.41 To 0.60 maximum FIO2 3 (33.33%) had sepsis. Out of 15 neonates with 0.61 to 0.90 maximum FIO2 5 (18.52%) had sepsis. Out of 5 neonates with 0.91 to 1 maximum FIO2, 5 (100%) had sepsis. Out of 54, the neonates with ≥

30 mm hg mean BP 14 (25.93%) had sepsis. Out of 15 neonates with 20 to 29 mm, hg BP 5 (33.33%) had sepsis. There was no statistically significant difference in sepsis between temperature with P value 1.00. There was no statistically significant difference in sepsis across PO2 with P value 0.213 majority of 8 (22.86%) neonates had >2.49 po2 with sepsis. Out of 53 neonates with ≥7.20 PH, 11 (20.75%) had sepsis. Out of 17 neonates with 7.10 to 7.19 PH 8 (47.06%) had sepsis. The difference in the proportion of sepsis between PH was statistically significant. (P value 0.034). The difference in the proportion of sepsis between urine output was statistically significant. (P value 0.002). There was no statistically significant difference in sepsis between APGAR Score with a P value of 0.752 majority of 14 (25.93%) had >=7 APGAR score with sepsis. There was no statistically significant difference in sepsis between birth weight with a P value of 0.472 majority of 18 (26.47%) had >=1.35Kg birth Wight with sepsis. There was no statistically significant difference in sepsis between seizures with P value of 0.146. There was no statistically significant difference in sepsis between SGA with P value 0.744. (Table 40)

Table 41: Comparison of parameters of CRIB and SNAP-PE II scores between AKI (N=70)

Parameter	AKI		Chi square/ t value	P value
	Yes	No		
Gestational age (Mean± SD)	36.68 ± 2.8	38.44 ± 2.02	-3.04	0.003
Max BE				
>-7 (N=28)	2 (7.14%)	26 (92.86%)	*	*
-7 To -9.9 (N=31)	21 (67.74%)	10 (32.26%)		
-10 To -14.9 (N=9)	8 (88.89%)	1 (11.11%)		
<=-15 (N=2)	0 (0%)	2 (100%)		
Minimum Fio2				
<=0.40 (N=37)	3 (8.11%)	34 (91.89%)	41.988	<0.001
0.41 To 0.60 (N=21)	17 (80.95%)	4 (19.05%)		
0.61 To 0.90 (N=12)	11 (91.67%)	1 (8.33%)		
Maximum Fio2				
<=0.40 (N=29)	1 (3.45%)	28 (96.55%)	*	*
0.41 To 0.60 (N=9)	3 (33.33%)	6 (66.67%)		
0.61 To 0.90 (N=27)	22 (81.48%)	5 (18.52%)		
0.91 To 1 (N=5)	5 (100%)	0 (0%)		
Mean Blood Pressure				
>= 30 MMHG (N=54)	16 (29.63%)	38 (70.37%)	*	*
20 To 29 MMHG (N=15)	14 (93.33%)	1 (6.67%)		
<20 MMHG (N=1)	1 (100%)	0 (0%)		
Temperature				
>96 (N=54)	17 (31.48%)	37 (68.52%)	*	<0.001
95 To 96 F (N=16)	14 (87.5%)	2 (12.5%)		
PO2				
>2.49 (N=35)	5 (14.29%)	30 (85.71%)	*	*
1 To 2.49 (N=25)	16 (64%)	9 (36%)		

0.3 To 0.99 (N=10)	10 (100%)	0 (0%)		
PH				
>=7.20 (N=53)	15 (28.3%)	38 (71.7%)	*	<0.001
7.10 To 7.19 (N=17)	16 (94.12%)	1 (5.88%)		
Urine output				
>=1 kg/ml (N=58)	21 (36.21%)	37 (63.79%)	*	0.004
0.1 To 0.9 Kg/ml (N=12)	10 (83.33%)	2 (16.67%)		
APGAR Score				
>=7 (N=54)	16 (29.63%)	38 (70.37%)	*	<0.001
<7 (N=16)	15 (93.75%)	1 (6.25%)		
Birth weight				
>=1.35Kg (N=68)	30 (44.12%)	38 (55.88%)	0.00	1.00
0.85 To 1.34 Kg (N=2)	1 (50%)	1 (50%)		
Seizures				
Yes (N=22)	11 (50%)	11 (50%)	*	0.607
No (N=48)	20 (41.67%)	28 (58.33%)		
SGA				
Yes (N=14)	13 (92.86%)	1 (7.14%)	*	<0.001
No (N=56)	18 (32.14%)	38 (67.86%)		

The mean gestational age in neonates with AKI was 36.68 ± 2.8 weeks, it was 38.44 ± 2.02 weeks in neonates without AKI. The difference in gestational age between AKI was statistically significant. (P value 0.003). Out of 28 neonates with >-7 max BE 2 (7.14%) has AKI, among neonates with -7 to -9.9 max BE 21 (67.74%) had AKI, among neonates with -10 to -14.9 max BE 8 (88.89%) had AKI. There was a statistically significant difference in AKI across minimum FIO2 with P value <0.001. Among the neonates with <=0.40 maximum FIO2, 1 (3.45%) had AKI, among neonates with 0.41 To 0.60 maximum FIO2, 3 (33.33%) had AKI, among neonates with 0.61 to 0.90 maximum FIO2, 22 (81.48%) had AKI and among neonates with 0.91 to 1 maximum FIO2, 5 (100%) had AKI. Among the neonates with >, = 30 mm hg mean BP 16

(29.63%) had AKI. Among neonates with 20 to 29 mm hg BP 14 (93.33%) had AKI and among neonates with <20 mm hg, only one subject had AKI. There was a statistically significant difference in AKI between temperature with P value <0.001. Among neonates with >2.49 PO2, 5 (14.29%) had AKI. Among neonates with 1 to 2.49 po2, 16 (64%) had AKI and among neonates with 0.3 to 0.99 PO2,10 (100%) had AKI. Among neonates with >=7.20 PH 15 (28.3%) had AKI and among neonates with 7.10 to 7.19 PH 16 (94.12%) had AKI. The difference in the proportion of AKI between PH was statistically significant. (P value<0.001). Among neonates with >=1 kg/ml urine output 21 (36.21%) had AKI and among neonates with 0.1 to 0.9 Kg/ml urine output 10 (83.33%) had AKI. The difference in the proportion of AKI between urine output was statistically significant. (P value 0.004). There was a statistically significant difference in AKI between APGAR Score with a P value of <0.001 majority of 16 (29.63%) had >=7 APGAR score with AKI. There was no statistically significant difference in AKI between birth weight with a P value of 1.00 majority of 30 (44.12%) had >=1.35Kg birth Wight with AKI. Among the neonates with seizures, 11 (50%) had AKI. The difference in the proportion of AKI between seizures was statistically not significant. (P value 0.607). Among the neonates with SGA 13 (92.86%) had AKI. The difference in the proportion of SGA between AKI was statistically significant. (P value <0.001). (Table 41)

Table 42: Comparison of parameters of CRIB and SNAP-PE II scores between seizures (N=70)

Parameter	Seizures		Chi square/ t value	P value
	Yes	No		
Gestational age (Mean± SD)	38.05 ± 1.59	37.49 ± 2.86	0.857	0.395
Max BE				
>-7 (N=28)	5 (17.86%)	23 (82.14%)	*	*
-7 To -9.9 (N=31)	15 (48.39%)	16 (51.61%)		
-10 To -14.9 (N=9)	2 (22.22%)	7 (77.78%)		
<=-15 (N=2)	0 (0%)	2 (100%)		
Minimum Fio2				
<=0.40 (N=37)	10 (27.03%)	27 (72.97%)	7.580	0.023
0.41 To 0.60 (N=21)	11 (52.38%)	10 (47.62%)		
0.61 To 0.90 (N=12)	1 (8.33%)	11 (91.67%)		
Maximum Fio2				
<=0.40 (N=29)	5 (17.24%)	24 (82.76%)	8.591	0.035
0.41 To 0.60 (N=9)	6 (66.67%)	3 (33.33%)		
0.61 To 0.90 (N=27)	10 (37.04%)	17 (62.96%)		
0.91 To 1 (N=5)	1 (20%)	4 (80%)		
Mean Blood Pressure				
>= 30 MMHG (N=54)	21 (38.89%)	33 (61.11%)	*	*
20 To 29 MMHG (N=15)	1 (6.67%)	14 (93.33%)		
<20 MMHG (N=1)	0 (0%)	1 (100%)		
Temperature				
>96 (N=54)	15 (27.78%)	39 (72.22%)	1.461	0.227
95 To 96 F (N=16)	7 (43.75%)	9 (56.25%)		
PO2				
>2.49 (N=35)	10 (28.57%)	25 (71.43%)	4.097	0.129
1 To 2.49 (N=25)	11 (44%)	14 (56%)		

0.3 To 0.99 (N=10)	1 (10%)	9 (90%)		
PH				
>=7.20 (N=53)	16 (30.19%)	37 (69.81%)	0.156	0.693
7.10 To 7.19 (N=17)	6 (35.29%)	11 (64.71%)		
Urine output				
>=1 kg/ml (N=58)	16 (27.59%)	42 (72.41%)	2.318	0.128
0.1 To 0.9 Kg/ml (N=12)	6 (50%)	6 (50%)		
APGAR Score				
>=7 (N=54)	12 (22.22%)	42 (77.78%)	9.291	0.002
<7 (N=16)	10 (62.5%)	6 (37.5%)		
Birth weight				
>=1.35Kg (N=68)	22 (32.35%)	46 (67.65%)	*	*
0.85 To 1.34 Kg (N=2)	0 (0%)	2 (100%)		
SGA				
Yes (N=14)	5 (35.71%)	9 (64.29%)	0.149	0.699
No (N=56)	17 (30.36%)	39 (69.64%)		

The mean gestational age in neonates with seizures was 38.05 ± 1.59 weeks, it was 37.49 ± 2.86 weeks in neonates without seizures. The difference in gestational age between seizures was statistically not significant. (p value 0.395). Among neonates with >-7 max BE 5 (17.86%) had seizures, among neonates with -7 to -9.9 max BE 15 (48.39%) had seizures and among neonates with -10 to -14.9 max BE 2 (22.22%) had seizures. There was a statistically significant difference in seizures across minimum FIO2 with P value 0.023 majority of 11 (52.38%) had 0.41 to 0.60 minimum FIO2 with seizures. There was a statistically significant difference in seizures across minimum FIO2 with P value 0.035 majority of 10 (37.04%) had 0.61 to 0.90 maximum FIO2 with seizures. Among the neonates with >= 30 mm hg mean BP 21 (38.89%) had seizures. Among neonates with 20 to 29 mm hg BP 1 (6.67%) had seizures. There was no statistically significant difference in seizures between temperature with p value 0.227. There

was no statistically significant difference in seizures between PO2 with p value 0.129. There was no statistically significant difference in seizures between PH with p value 0.693. There was no statistically significant difference in seizures between urine output with p value 0.128. There was a statistically significant difference in seizures between APGAR score with a p value of 0.002 majority of 12 (22.22%) had >=7 APGAR score with seizures. Among neonates with >=1.35Kg birth weight 22 (32.35%) had seizures. Among the neonates with SGA 5 (35.71%) had seizures. The difference in the proportion of SGA between seizures was statistically not significant. (p value 0.699). (Table 42)

Table 43: Comparison of parameters of CRIB and SNAP-PE II scores between Hypoglycemia (N=70)

Parameter	Hypoglycemia		Chi square/ t value	P value
	Yes	No		
Gestational age (Mean± SD)	35.63 ± 3.04	38.65 ± 1.46	-5.62	<0.001
Max BE				
>-7 (N=28)	8 (28.57%)	20 (71.43%)	*	*
-7 To -9.9 (N=31)	15 (48.39%)	16 (51.61%)		
-10 To -14.9 (N=9)	0 (0%)	9 (100%)		
<=-15 (N=2)	0 (0%)	2 (100%)		
Minimum Fio2				
<=0.40 (N=37)	8 (21.62%)	29 (78.38%)	11.575	0.003
0.41 To 0.60 (N=21)	13 (61.9%)	8 (38.1%)		
0.61 To 0.90 (N=12)	2 (16.67%)	10 (83.33%)		
Maximum Fio2				
<=0.40 (N=29)	6 (20.69%)	23 (79.31%)	7.198	0.066
0.41 To 0.60 (N=9)	2 (22.22%)	7 (77.78%)		
0.61 To 0.90 (N=27)	14 (51.85%)	13 (48.15%)		
0.91 To 1 (N=5)	1 (20%)	4 (80%)		
Mean Blood Pressure				

>= 30 MMHG (N=54)	15 (27.78%)	39 (72.22%)	*	*
20 To 29 MMHG (N=15)	8 (53.33%)	7 (46.67%)		
<20 MMHG (N=1)	0 (0%)	1 (100%)		
Temperature				
>96 (N=54)	18 (33.33%)	36 (66.67%)	0.024	0.876
95 To 96 F (N=16)	5 (31.25%)	11 (68.75%)		
PO2				
>2.49 (N=35)	11 (31.43%)	24 (68.57%)	3.808	0.149
1 To 2.49 (N=25)	11 (44%)	14 (56%)		
0.3 To 0.99 (N=10)	1 (10%)	9 (90%)		
PH				
>=7.20 (N=53)	18 (33.96%)	35 (66.04%)	0.121	0.728
7.10 To 7.19 (N=17)	5 (29.41%)	12 (70.59%)		
Urine output				
>=1 kg/ml (N=58)	21 (36.21%)	37 (63.79%)	*	0.313
0.1 To 0.9 Kg/ml (N=12)	2 (16.67%)	10 (83.33%)		
APGAR Score				
>=7 (N=54)	18 (33.33%)	36 (66.67%)	0.024	0.876
<7 (N=16)	5 (31.25%)	11 (68.75%)		
Birth weight				
>=1.35Kg (N=68)	21 (30.88%)	47 (69.12%)	*	*
0.85 To 1.34 Kg (N=2)	2 (100%)	0 (0%)		
Seizures				
Yes	6 (27.27%)	16 (72.73%)	0.454	0.501
No	17 (35.42%)	31 (64.58%)		
SGA				
Yes (N=14)	10 (71.43%)	4 (28.57%)	*	0.001
No (N=56)	13 (23.21%)	43 (76.79%)		

**No statistical test was applied- due to 0 subjects in the cells*

The mean gestational age in neonates with hypoglycemia was 35.63 ± 3.04 weeks, it was 38.65 ± 1.46 weeks in neonates without hypoglycemia. The difference in gestational age between hypoglycemia was statistically significant. (P value <0.001). Among neonates with max BE >-7, 8 (28.57%) participants had hypoglycemia. Among neonates with max BE -7 to -9.9, 15 (48.39%) participants had hypoglycemia. The difference in hypoglycemia between the minimum fio2 levels is found to be significant with a p-value of 0.003. The difference in hypoglycemia between the maximum fio2 levels is found to be insignificant with a P- value of 0.066. Out of 54 participants with mean blood pressure ≥30 Mm/hg, 15 (27.78%) participants had hypoglycemia. Out of 15 participants with mean blood pressure 20 to 29 Mm/hg, 8(53.33%) neonates had hypoglycemia. The difference in hypoglycemia between the temperature levels is found to be insignificant with a P- value of 0.876. The difference in hypoglycemia between the po2 levels is found to be insignificant with a P- value of 0.149. The difference in hypoglycemia between the PH levels is found to be insignificant with a P- value of 0.728. The difference in hypoglycemia between the urine output levels is found to be insignificant with a P- value of 0.313. The difference in hypoglycemia between the APGAR score is found to be insignificant with a P- value of 0.876. Out of 68 neonates with ≥1.35 birth weight, 21 (30.88%) had hypoglycemia. Out of 2 neonates with 0.75 to 0.99kg, 2 (100%) participants had hypoglycemia. The difference in hypoglycemia between the seizures is found to be insignificant with a P- value of 0.501. Among neonates with SGA 10 (71.43%) had hypoglycemia. The difference in the proportion of hypoglycemia between SGA was statistically significant. (P value 0.001). (Table 43)

DISCUSSION

DISCUSSION:

In spite of extensive care of NICU, prematurity and sepsis has been a major concern for mortality among infants. Prematurity ranks highest in the cause of neonatal death and in addition very low preterm for GA infants the survival chances becomes indefinite.[85] Infants born with birth weight very less than thousand gm along with age of gestation less than 28 weeks together adds to the risk for morbid and mortality conditions. Hence it becomes very important to identify these neonates as the pediatricians and health providers can be initiated for further treatments at every stages of NICU.[86] Various scoring systems have been evolved till date to predict the mortality and morbidity of neonates within few hours of life. The univariate variables studied by most of clinicians and investigators are birth weight, gestational age APGAR score and serum albumin levels.[87, 88] Whereas, scoring systems such as CRIB II, SNAP, SNAPPE II predicting infant mortality has been researched and found to good in predicting short come and long-term outcome of neonates born before 32 weeks of gestation. These scoring systems use numerous parameters in achieving a score which predicts mortality and morbidity of neonates. But there is a lack of guidelines, implementation of scoring system among referred neonates These parameters include a variety of univariate variables. Hence in the present study we aimed to assess the predictability of neonatal mortality and morbidity using CRIB II and SNAPE II scores and Parameters associated with morbidity and mortality in referred neonates.

Descriptive analysis:

A total of 70 participants were comprised in the final analysis. Majority of the participants were male 45(64.3%) and remaining 25 (35.7%) participants were female. The mean blood pressure was 53.21 ± 17.74 in the study population. The mean temperature was 97.02 ± 1.26 in the study population. The mean Po2/Fio2 was 3.66 ± 5.6 in the study population. The mean PH was 7.3

± 0.12 in the study population. The mean urine output was 1.2 ± 0.35 in the study population. The mean APGAR score was 7.46 ± 1.63 in the study population. The mean birth weight was 2.61 ± 0.68 in the study population. The mean gestational age was 37.66 ± 2.53 weeks in the study population, ranged between 32 to 42 weeks (95% CI 37.06 to 38.27).

The mean max base excess was -6.87 ± 5.17 in the study population. Among the study population, 14 (20%) participants were small for gestational age. The mean Minimum Fio2 was 0.43 ± 0.19 in the study population. The mean Max Fio2 0.62 ± 0.24 in the study population. Majority of neonates had of SIRS 44 (62.9%) followed by sepsis 19(27.1%), MODS 8(11.4%), septic shock 13 (18.6%), AKI 31 (44.3%), seizures 22(31.4%), hypoglycemia 23(32.9%), and hyperbilirubinemia 4(5.7%).

Among the study population, 9 (12.9%) participants were dead. Among the neonates with blood pressure level, 54 (77.1%) participants had ≥30 mm/hg, 15 (21.4%) participants had 20 to 29 mm/hg and only 1 (1.4%) participant had <20 mm/hg. Among the neonates with temperature level, 54 (77.1%) participants had >96 F and 16 (22.9%) participants had 95 to 96 F. Among the neonates with po2 level, 35 (50%) participants had >2.49, 25 (35.7%) participants had 1 to 2.49 and 10 (14.3%) participant had 0.3 to 0.99. Among the neonates with PH level, 53 (75.7%) participants had ≥7.20 and 17 (24.3%) participants had 7.10 to 7.19. Among the neonates with urine output level, 58 (82.9%) participants had ≥1 ml/kg and 12 (17.1%) participants had 0.1 to 0.90 ml/kg. Among the neonates with APGAR score, 54 (77.1%) participants had ≥7 and 16 (22.9%) participants had <7. Among the study population, 69 (98.6%) neonates had ≥1 kg and only 1 (1.4%) child had 0.75 to 0.99 kg. Among the study population, 68 (97.1%) neonates had ≥1.35 kg and 2 (2.9%) neonates had 0.85 to 1.34 kg. Among the neonates with max BE, 28 (40%) participants had >-7, 31 (44.3%) participants had -7 to -9.9, 9 (12.9%) participants had

-10 to 14.9 and 2 (2.9%) participants had ≤ -15 max BE. Among the neonates with minimum FIO2, 37 (52.9%) participants had ≤0.40, 21 (30%) participants had 0.41 to 0.60 and 12 (17.1%) participants had 0.61 to 0.90. Among the neonates with maximum FIO2, 29 (41.4%) participants had ≤0.40, 9 (12.9%) participants had 0.41 to 0.60, 27 (38.6%) participants had 0.91 to 1.

Table 44: Studies comparing various parameters with the present study

Studies	Total no of study population	mean Birth weight	Gender		Gestational age (Weeks)	Mean CRIB II scores	temperature	Base excess
			males	females				
Ezz-Eldin ZM et al[10]	113	1134.5 ± 202.0 gm	51.3 %	48.7%	28.7±2.1	9.9 ± 4.0	34.6 ± 1.4 Celsius	-11.5 ± 6.0,
Rastogi, PK et al[59]	86	1228 ± 398 g	100%	-	28.3±2.4	8.29 ± 4.35	-	-
Muktan, D et al[61]	255	2422.9	69 %	31%	36.8±0.2	-	-	-
Present study	70	2.61 ± 0.68 kg	64.3 %	35.7%	37.66±2.53	3.6 ± 3.6	97.02 ± 1.26	-6.87 ± 5.17

Comparison of SNAPE II scores with neonatal mortality and morbidity

In the present study, the mean SNAP-PE II Score was 23.34 ± 23.14 in the study population. Muktan, D et al[61], study showed significantly higher scores in infants who were dead than compared to the survived ones. This study found SNAPPEE II score ≥38 as a good predictor for infant mortality and found no correlation between NICU duration of stay and the score. Few studies conducted in Indonesia[89], and Paraguay[90], found SNAPEE II score ≥40 whereas in Indian studies[91] [12], found a score of ≥37 all significantly associated with greater mortality. However, other studies[63, 92], found even the highest score of ≥51 and ≥33 SNAPEE II scores associated with increased mortality. In our study also we found an infant who had dead with

the median SNAP-PE II score of 58 (IQR 41 to 58). The difference in the SNAP-PE II score between dead was statistically significant (P Value <0.001). These variations in the cut off values among these studies may have resulted due to confounding factors such as the intensity of illness, underlying diseases, congenital abnormalities and including the poor infrastructure of NICU. Few studies[12, 65, 66], have also shown a significant positive correlation between SNAPEE II scores and duration of stay in NICU (r= 0,045). However, in our study, we found no such correlation.

In the present study, we observed that among infants with sepsis, the median SNAP-PE II score was 23 (IQR 0 to 54) and it was 13 (IQR 0 to 42) in neonates without sepsis. Among the neonates with Seizures, the median SNAP-PE II score was 34 (IQR 5 to 49) and it was 6.5 (IQR 0 to 42) in neonates without Seizures. Among the neonates with hypoglycemia, the median SNAP-PE II score was 42 (IQR 0 to 42) and it was 5 (IQR 0 to 48) in neonates without hypoglycemia. Among the neonates with hyperbilirubinemia, the median SNAP-PE II score was 0 (IQR 0 to 16.5) and it was 20.5 (IQR 0 to 45.75) in neonates without hyperbilirubinemia. The difference in the SNAP-PE II score between neonates with and without sepsis, seizures, hypoglycemia and hyperbiluremia group, was statistically not significant (P Value >0.05). Among the neonates with AKI, the median SNAP-PE II score was 45 (IQR 41 to 54) and it was 0 (IQR 0 to 5) in neonates without AKI. The difference in the SNAP-PE II score between neonates with and without AKI group was statistically significant (P Value <0.001). Although, various morbid conditions of the neonates showed no statistically significant, one can observe that the score of SNAPEE II is high in neonates with morbid conditions irrespective to gestational age as our study has only included gestational age >37 weeks.

Table 45: comparing SNAPEE II scores with the present study

Studies	SNAPEE II scores
Mia, R et al[89], and Mesquita, RMN et al[90]	≥40
Niranjan, H et al[91] and Harsha, SS[12]	≥37
Thimoty, J et al[92]	≥51
Ucar, S et al [63]	≥33
Dammann, et al[64]	≥30
Present study	23.34 ± 23.14

Table 46: comparing SNAPEE II scores and mortality among studies with the present study

Studies	Total number of mortalities	SNAPEE II score	Total number survived	SNAPEE II score
Harsha, SS et al[12]	39	45.72	209	21.04
Mia, RA et al[89]	-	42.75±18.59	-	17.4±14.05.
Current study	9	58	61	23.34

Hence the table above comparing SNAPEE II scores between dead and survived infants infers that greater the score of SNAPEE II the risk of mortality is increased. Thus, supporting the evidence, SNAPEE II scores can be used to predict the mortality of infants regardless of gestational age during admission and not predict the later outcomes of neonates.

Comparison of CRIB II scores with mortality and morbidity

The mean CRIB II was 3.6 ± 3.6 in the study population. Ranged between 0 to 10 (95% CI 2.74 to 4.46). Among the neonates who had dead, the median CRIB II was 8 (IQR 8 to 10). The difference in the CRIB II between death was statistically significant (P Value <0.001). The neonates with sepsis had the median CRIB II was 5(IQR 0 to 10), and it was 2 (IQR 0 to 6) in neonates without sepsis. Among the neonates with Seizures, the median CRIB II was 4 (IQR

1.75 to 6) and it was 1 (IQR 0 to 8) in neonates without Seizures. Among the neonates with hypoglycemia, the median CRIB II was 4 (IQR 0 to 8) and it was 2 (IQR 0 to 6) in neonates without hypoglycemia. Among the neonates with hyperbilirubinemia, the median CRIB II was 0 (IQR 0 to 1.5) and it was 4 (IQR 0 to 8) in neonates without hyperbilirubinemia. The difference in the CRIB II between neonates with and without sepsis, seizures, hypoglycemia and hyperbilirubinemia group was statistically not significant (P Value 0.162). But among the neonates with AKI, the median CRIB II was 8 (IQR 6 to 8) and it was 0 (IQR 0 to 2) in neonates without AKI. The difference in the CRIB II between neonates with and without AKI group was statistically significant (P Value <0.001).

Marete, IK et al[93], study found the mean CRIB II score at admission was 5.5 (Range 1 –15) among 45.9% of dead neonates. Survivors had a mean CRIB II score of 3.7, while non-survivors had a mean CRIB score of 7.7. It is well appreciated from the table below that the studies show that the low score shows better survival chances of neonates while the high score of CRIBB II with increased risk of mortality. The same was observed in the present study also where the infants who did not survive had a score of 8. The present study scores were in comparison to a study by Sarquis, ALF et al[83], which found a mean CRIB II score of 4, range of 0 –19.

Table 47: comparing CRIB II scores with the present study

Studies	Mean CRIB II scores
Marete IK et al[93]	5 ± 10
Ezz-Eldin ZM et al[10]	9.9 ± 4.0
Rastogi, PK et al[59]	8.29 ± 4.35
Sarquis ALF et al[83]	4
Present study	3.6 ± 3.6

Table 48: comparing CRIBB II scores and mortality among studies with the present study

Studies	Total number of mortalities	CRIBB II score of dead neonates	Total number survived	CRIBB II score of survived neonates
Marete IK et al[93]	-	7.7	-	3.7
Current study	9	58	61	23.34

Comparison of parameters of CRIB and SNAP-PE II scores between death

Out of 54 neonates with mean blood pressure ≥30 Mm/hg, only one (1.85%) participant were dead. Out of 15 neonates with 20 to 29 mm, hg means BP 7 (46.67%) were dead. Out of 1 child with <20 mm hg 1 (100%) was dead. The difference in death between the temperature is found to be significant with a P- value of 0.003. The difference in death between the APGAR score is found to be insignificant with a P- value of 1.000. Out of 68 neonates with ≥1.35 kg birth weight, 9 (13.24%) participants were dead. Out of 31 neonates with max BE -7 to -9.9, 2 (6.45%) participants were dead. Out of 91 neonates had max BE -10 to -14.9, 7 (77.78%) neonates were dead. Out of 21 neonates with minimum fio2 0.41 to 0.60, only 1 (4.76%) was dead. Out of 12 neonates with minimum fio2 0.61 to 0.90, 8 (66.67%) were dead. Out of 9 neonates with maximum fio2 0.41 to 0.60, only 1 (11.11%) was dead. Out of 27 neonates with minimum fio2 0.61 to 0.90, 5 (18.52%) participants were dead. Out of 27 neonates with minimum fio2 0.91 to 1, 3 (60%) participants were dead. The mean gestational age in the death group was 39.07 ± 1.27 years, it was 37.45 ± 2.61 in no death group. The difference in gestational age between death was statistically not significant. (P value 0.074).

The difference in gestational age between SIRS was statistically significant (p value 0.001). There was a statistically significant difference in SIRS between temperature with p value 0.003. There was a statistically significant difference in SIRS across PO2 with p value 0.002. The difference in the proportion of SIRS between Ph was statistically significant. (p value 0.003). There was a statistically significant difference in SIRS between APGAR score with a p value

of 0.003. The difference in the proportion of sirs between seizures was statistically not significant. (p value 0.927).

Over the years, many studies[10 94], have suggested that birth weight, gestational age of neonates had a significant association with neonatal death. Few reports also accept that birth weight and gestational age of neonates could also predict the long -term neonatal death.[95] However in contrast a study conducted in Brazil found weight during birth to be the least predictor of death.[74] An Asian studies have found several risk factors related to newborn mortality as low birth weight, sepsis eclampsia, low socioeconomic levels, haemorrhage etc.[96] However in our study gestational age and birth weight were not significantly associated with mortality as the study population were term babies with birth weight appropriate for age.

In the study performed by Szymonska, I. et al[97], it has been found out that lower gestational age ($p = 0.02$) and higher CRIB II score ($p < 0.01$) were positively associated with hyperglycaemia. In the current study, among the neonates with hypoglycemia, the median CRIB II was 4 (IQR 0 to 8), and it was 2 (IQR 0 to 6) in neonates without hypoglycemia. The difference in the CRIB II between neonates with and without hypoglycemia group was statistically not significant (P Value 0.196).

Daga, A. et al[14], in 2017 did the regression analysis and found CRIB II scores to be an independent risk factor for AKI (odds ratio = 1.621; 95% confidence interval, 1.230-2.167; $p = 0.001$). In the present study, we found 31 (44.3%) participants, the CRIB II score was <0.001 and had AKI. There was a slight statistically significance in P value for both scores.

Conclusions:

The current study performed the CRIB, and SNAP-PE II score on all referred neonates to identify neonates with the risk of mortality and morbidity. And further, assess the parameters of the two scores which associated with poor morbidity and mortality. The mean SNAP-PE II Score was 23.34 ± 23.14 in the study population. Among infants found dead had the median SNAP-PE II score of 58 (IQR 41 to 58). The difference in the SNAP-PE II score between dead was statistically significant (P Value <0.001). The mean CRIB II was 3.6 ± 3.6 in the study population. Ranged between 0 to 10 (95% CI 2.74 to 4.46). Among the neonates who had dead, the median CRIB II was 8 (IQR 8 to 10). The difference in the CRIB II between death was statistically significant (P Value <0.001). The difference in the SNAP-PE II score between neonates with and without sepsis, seizures, hypoglycemia and hyperbiluremia group, was statistically not significant (P Value >0.05). Among the neonates with AKI, the median SNAP-PE II score was 45 (IQR 41 to 54), and it was 0 (IQR 0 to 5) in neonates without AKI. The difference in the SNAP-PE II score between neonates with and without AKI group was statistically significant (P Value <0.001). The difference in the CRIB II between neonates with and without sepsis, seizures, hypoglycemia and hyperbilirubinemia group was statistically not significant (P Value 0.162). But among the neonates with AKI, the median CRIB II was 8 (IQR 6 to 8), and it was 0 (IQR 0 to 2) in neonates without AKI. The difference in the CRIB II between neonates with and without AKI group was statistically significant (P Value <0.001). The difference between death and temperature, base excess, blood pressure was found to significant. The present study the scores of SNAPPE II and CRIB II was very beneficial tools in assess the severity of illness and prognosis. Among the individual parameters of CRIB II and SNAP-PE II- the neonate's gestational age(prematurity), temperature at admission, pH, APGAR score at 5mins, urine output(oliguria), Minimum FiO2 requirement at admission, Small for gestational age were found to be associated with poor outcomes- morbidity and

mortality. Thus, a referral policy should be implemented for referral of neonates and their transport as correction of these variables prior to or during referral will lead to decrease in morbidity and mortality in referred neonates. Thus, these findings can be implicated in NICU routinely to know the most critical newborn for prioritizing the management and for the purpose of counselling the parents. This score might also be used to compare the effectiveness of various NICU across the country which will help to improve the facilities provided by different NICUs.

Summary

Prematurity followed by sepsis are the major cause of mortality of neonates in the world. Various risk factors involved in deaths of infants warrants the need for a useful tool in predicting mortality and morbidity among neonates. Various scoring systems have been evolved till date and few of them have been modified to ease out the use among health care professional and to provide necessary treatment at the earliest. CRIBB II and SNAPEE II are two such scoring systems which are widely accepted and used in identifying high-risk neonates. Hence the present study we aimed to use CRIB and SNAP-PE II score on all referred neonates to identify neonates with the risk of mortality and morbidity. And further, assess the parameters of the two scores which associated with poor morbidity and mortality.

A total of 70 subjects were included in the final analysis. Majority of the participants were male 45(64.3%) and remaining 25 (35.7%) participants were female. The mean blood pressure was 53.21 ± 17.74 in the study population. The mean temperature was 97.02 ± 1.26 in the study population. The mean Po2/Fio2 was 3.66 ± 5.6 in the study population. The mean PH was 7.3 ± 0.12 in the study population. The mean urine output was 1.2 ± 0.35 in the study population. The mean APGAR score was 7.46 ± 1.63 in the study population. The mean birth weight was 2.61 ± 0.68 in the study population. The mean gestational age was 37.66 ± 2.53 weeks in the study population, ranged between 32 to 42 weeks (95% CI 37.06 to 38.27).

The mean max base excess was -6.87 ± 5.17 in the study population. Among the study population, 14 (20%) participants were small for gestational age. The mean Minimum Fio2 was 0.43 ± 0.19 in the study population. The mean Max Fio2 0.62 ± 0.24 in the study population. Majority of neonates had of SIRS 44 (62.9%) followed by sepsis 19(27.1%), MODS 8(11.4%), septic shock 13 (18.6%), AKI 31 (44.3%), seizures 22(31.4%), hypoglycemia 23(32.9%), and hyperbilirubinemia 4(5.7%).

The mean SNAP-PE II Score was 23.34 ± 23.14 in the study population. Among infants found dead had the median SNAP-PE II score of 58 (IQR 41 to 58). The difference in the SNAP-PE II score between dead was statistically significant (P Value <0.001).The mean CRIB II was 3.6 ± 3.6 in the study population. Ranged between 0 to 10 (95% CI 2.74 to 4.46). Among the neonates who had dead, the median CRIB II was 8 (IQR 8 to 10). The difference in the CRIB II between death was statistically significant (P Value <0.001). The difference in the SNAP-PE II score between neonates with and without sepsis, seizures, hypoglycemia and hyperbiluremia group, was statistically not significant (P Value >0.05). The difference in death between the parameters of temperature, pH level, and urine output found to be significant with a P value of 0.003, <0.001, and 0.041 respectively.

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ANNEXURES

A study of Clinical Risk index Of Babies II (CRIB II) and Score for Neonatal Acute Physiology II (SNAP-PE II) to identify clinical parameters associated with poor outcomes in referred neonates

PROFORMA

Sl no: **Date:**

NAME OF MOTHER:

UHID No:

NAME OF FATHER:

ADDRESS:

SEX:

DATE OF BIRTH:

TIME OF BIRTH:

PLACE OF BIRTH:

DATE OF ADMISSION:

SNAP-PE II SCORE AT ADMISSION

VARIABLE	VALUE	SCORE	OBTAINED SCORE
MEAN BLOOD PRESSURE	>= 30 mmHG 20-29 mmHG <20 mmHG	0 9 19	
TEMPERATURE	>96^{O}F 95^{O}-96^{O}F <95^{O}F	0 8 15	
PO_2(mmHG)/FiO_2(%)	>2.49 1.0-2.49 0.3-0.99	0 5 16	

	<0.3	28	
pH	>=7.20 7.10-7.19 <7.6	0 7 16	
SEIZURES	NO YES	0 19	
URINE OUTPUT	>= 1ml/kg 0.1-0.9 ml/kg < 0.1 ml/kg	0 5 18	
APGAR SCORE	>= 7 < 7	0 18	
BIRTH WEIGHT	>1000 grams 750-999 grams < 750 grams	0 10 17	
SMALL FOR GESTATIONAL AGE	>3RD centile < 3RD centile	0 12	

TOTAL SCORE=

CRIB II SCORE AT ADMISSION

VARIABLE	VALUE	SCORE	OBTAINED SCORE
BIRTH WEIGHT (grams)	>1350 851-1350 701-850 <=700	0 1 4 7	
GESTATIONAL AGE (WEEKS)	<24 >=24	0 1	
CONGENITAL MALFORMATION	NONE NO IMMINENT LIFE THREATENING IMMINENT LIFE THREATENING	0 1 3	
MAXIMUM BASE EXCESS (mmol/l)	>-7 -7 TO -9.9 -10.0 TO -14.9 <= -15	0 1 2 3	
MINIMAL APPROPRIATE FiO_2	<= 0.40 0.41 – 0.60 0.61 - 0.90 0.91 – 1.00	0 2 3 4	
MAXIMUM APPROPRIATE FiO_2	<= 0.40 0.41 – 0.80 0.81 – 0.90 0.91 – 1.00	0 1 3 5	

TOTAL SCORE=

FOLLOW-UP

Variable		At admission	12 hours	24 hours	Day 2	Day 3	Day 4,5...day of discharge.
1.Systemic Inflammatory Response Syndrome(SIRS)	Yes No						
2.Sepsis	Yes No						
3.Multi Organ Dysfunction Syndrome (MODS)	Yes No						
4.Septic shock	Yes No						
5.Acute Kidney Injury-							
nRIFLE criteria							
Risk-urine output <1.5 ml/ kg/hour X 24 hours	Yes No						
Injury-urine output <1ml/kg/hour X 24 hours	Yes No						
Failure-urine output < 0.7 ml/kg/hour X 24 hours or anuria X 12 hours	Yes						

	No						
Loss- Persistent failure > 4 weeks	Yes No						
End stage- End-stage renal disease (persistent failure > 3 months)	Yes No						
6.Seizures	Yes No						
7.Hypoglycemia- GRBS < 45 mg/dl	Yes No						
8.Hyperbilirubinemia	Yes No						
9. Death	Yes No						

A study of Clinical Risk index Of Babies II (CRIB II) and Score for Neonatal Acute Physiology II(SNAP-PE II) to identify clinical parameters associated with poor outcomes in referred neonates

Patient Information Sheet

Principal Investigator: Dr. S K Mohammed Yasar/ Dr. K N V Prasad

I, Dr S K Mohammed Yasar , post-graduate student in Department of Paediatrics at Sri Devaraj Urs Medical College, will be conducting a study titled…….. "**A study of Clinical Risk index Of Babies II (CRIB II) and Score for Neonatal Acute Physiology II(SNAP-PE II) to identify clinical parameters associated with poor outcomes in referred neonates**." for my dissertation under the guidance of Dr. K N V Prasad, Professor, Head of the department, Department of Paediatrics. The participants of this study i.e. neonate will be included in a observational study wherein the CRIB II and SNAP-PE II score will be applied at admission to the hospital, which involves performing Arterial Blood Gas analysis on the subject.

You will not be paid any financial compensation for the participation of your child in this research project.

All the data will be kept confidential and will be used only for research purpose by this institution. You are free to provide consent for the participation of your child in the study. You can also withdraw your child from the study at any point of time without giving any reasons whatsoever. Your refusal to participate will not prejudice you to any present or future care at this institution.

Name and Signature of the Principal Investigator

Date

INFORMED CONSENT FORM

Date:

I, Mr/Mrs _____ , have been explained in my own vernacular language that my child _____will be included in the study, **A study of Clinical Risk index Of Babies II (CRIB II) and Score for Neonatal Acute Physiology II(SNAP-PE II) to identify clinical parameters associated with poor outcomes in referred neonates,**hereby give my valid written informed consent without any force or prejudice for recording the observations of parameters in the CRIB II and SNAP-PE II score inclucing Arterial Blood Gas analysis . The nature and risks involved have been explained to me, to my satisfaction. I have been explained in detail about the study being conducted. I have read the patient information sheet and I have had the opportunity to ask any question. Any question that I have asked, have been answered to my satisfaction. I provide consent voluntarily to allow my child as a participant in this research. I hereby give consent to provide history, undergo physical examination, undergo the procedure, undergo investigations and provide its results and documents etc to the doctor / institute etc. For academic and scientific purpose the operation / procedure, etc may be video graphed or photographed. All the data may be published or used for any academic purpose. I will not hold the doctors / institute etc responsible for any untoward consequences during the procedure / study.

A copy of this Informed Consent Form and Patient Information Sheet has been provided to the participant.

_____ _____

(Signature & Name of Pt. Attendant) (Signature/Thumb impression & Name of Patient/Guardian)

(Relation with patient)

Witness:

_____

(Signature & Name of Research person /doctor)

MASTER SHEET

S. No	Gender	Mean blood pressure	Temperature	PO2FiO2mmHg	pH	Urine output ml/kg	APGAR	Small for gestational age	SNAPPEII score	Birth weight	Gestational age	Congenital mal formation	Max BE	Minimum Fio2	Max Fio2	CRIBII	SIRS	MODS	SEPTICSHOCK	SEPSIS	AKI	Seizures	Hypoglycemia	Hyperbilirubinemia	Death
1	2	60	95.0	0.60	7.12	1.30	6	2	65	2.40	38.40	2	-13.50	0.70	1.00	10	1	2	1	1	1	2	2	2	2
2	1	56	98.0	4.50	7.35	1.60	7	1	31	2.18	37.20	2	-4.00	0.40	0.60	1	1	2	2	1	1	1	1	2	2
3	2	65	98.0	4.70	7.36	1.50	8	2	0	3.20	38.00	2	-2.50	0.21	0.40	0	2	2	2	1	2	2	2	2	2
4	1	65	98.4	3.00	7.34	1.20	9	2	0	3.00	38.00	2	-2.00	0.21	0.40	0	2	2	2	2	2	2	2	1	2
5	1	70	97.0	1.60	7.22	1.40	5	2	23	2.60	39.00	2	-8.00	0.40	0.80	6	1	2	2	2	1	2	2	2	2
6	1	66	98.0	0.60	7.14	1.30	4	2	41	2.50	37.00	2	-13.00	0.60	0.90	8	2	2	2	2	1	1	2	2	2
7	2	56	97.4	1.80	7.24	1.20	7	2	5	2.42	37.40	2	-8.00	0.40	0.60	4	2	2	2	2	2	2	2	2	2
8	2	66	99.0	3.80	7.36	1.60	8	2	0	3.16	39.00	2	-4.00	0.21	0.40	0	1	2	2	1	2	2	2	2	2
9	1	25	97.0	2.20	7.52	1.00	9	1	42	1.36	32.00	2	8.00	0.60	0.90	8	1	2	1	2	1	2	1	2	2
10	1	66	98.0	4.50	7.36	1.40	8	2	0	3.30	40.00	2	-3.00	0.21	0.40	0	2	2	2	2	2	2	1	2	2
11	2	24	95.0	0.60	7.12	1.00	7	2	58	3.60	40.00	2	-12.00	0.70	0.90	8	1	1	1	2	1	2	2	2	1
12	1	65	98.0	2.00	7.30	1.00	8	2	5	2.40	40.00	2	-8.00	0.40	0.60	2	2	2	2	2	2	1	2	2	2
13	1	72	98.0	4.70	7.38	1.70	9	2	0	3.00	39.50	2	-2.40	0.21	0.40	0	2	2	2	2	2	2	2	2	2
14	1	66	96.0	0.40	7.11	0.60	4	2	54	2.70	39.50	2	-8.80	0.80	1.00	10	1	2	1	1	1	2	2	2	2
15	1	24	95.0	0.60	7.12	0.80	8	2	45	2.88	37.40	2	-9.00	0.80	1.00	10	1	2	1	1	1	2	1	2	1
16	2	68	96.0	2.40	7.24	0.70	8	2	13	2.46	36.60	2	-7.60	0.40	0.80	4	1	2	2	1	2	1	2	2	2
17	2	66	98.0	5.60	7.35	1.30	9	2	0	3.14	38.30	2	-3.00	0.21	0.40	0	2	2	2	2	2	2	2	2	2
18	1	54	97.0	2.40	7.22	1.00	7	1	22	0.96	32.00	2	-8.40	0.50	0.80	5	1	2	2	1	2	2	1	2	2
19	1	64	96.0	4.60	7.30	1.40	8	2	13	2.88	39.20	2	-7.40	0.30	0.60	2	2	2	2	2	2	1	2	2	2
20	1	66	98.0	5.40	7.34	1.20	8	2	0	3.12	40.00	2	-3.00	0.21	0.40	0	1	2	2	1	2	2	2	1	2
21	1	58	98.4	4.80	7.40	1.10	8	2	37	2.56	38.30	2	-4.00	0.21	0.40	0	1	2	2	2	2	1	2	2	2
22	1	23	96.0	2.40	7.16	0.70	4	2	71	3.10	40.20	2	-12.60	0.70	1.00	10	1	1	1	1	1	1	2	2	1
23	2	25	97.0	2.20	7.52	1.00	9	1	42	1.40	32.00	2	-8.40	0.60	0.90	8	1	2	2	2	1	2	1	2	2
24	1	64	96.0	2.10	7.30	0.70	5	1	48	2.10	38.00	2	-8.00	0.50	0.90	6	1	2	2	2	1	1	2	2	2

25	1	25	98.0	2.30	7.34	1.00	9	1	42	1.80	34.00	2	-9.20	0.60	0.90	8	1	2	2	2	1	2	1	2	2
26	2	26	95.3	3.40	7.12	0.20	7	2	58	3.80	40.00	2	-12.00	0.70	0.90	8	1	1	1	1	2	2	2	2	1
27	1	58	97.0	4.20	7.36	1.20	8	2	0	2.56	40.00	2	-4.00	0.21	0.30	0	2	2	2	2	2	2	2	2	2
28	1	50	95.6	1.50	7.40	0.60	5	1	48	2.30	39.00	2	-7.70	0.50	0.00	6	1	2	2	2	1	1	2	2	2
29	2	56	96.0	2.30	7.35	1.20	8	2	13	2.64	38.00	2	-8.00	0.50	0.60	4	1	2	2	2	2	1	2	2	1
30	1	58	98.0	4.60	7.37	1.30	9	2	0	2.40	38.00	2	-3.00	0.21	0.40	0	1	2	2	2	2	2	2	2	2
31	1	70	96.0	0.40	7.11	0.80	4	2	54	2.80	38.50	2	-8.80	0.80	0.60	6	1	2	1	1	1	2	2	2	2
32	1	60	98.0	4.40	7.34	1.30	9	2	0	2.60	38.00	2	-3.44	0.21	0.40	0	2	2	2	2	2	2	2	2	2
33	1	54	95.0	3.90	7.13	1.40	5	2	52	2.73	37.50	2	-8.20	0.57	0.66	4	1	2	2	2	1	1	1	2	2
34	1	68	97.0	5.60	7.28	1.30	7	2	0	1.48	33.00	2	-3.00	0.20	0.40	0	1	2	2	1	2	2	1	1	2
35	2	72	96.0	2.20	7.50	1.70	9	2	13	2.80	38.50	2	-8.80	0.58	0.76	4	1	2	2	2	1	2	1	2	2
36	1	76	97.0	4.80	7.40	1.70	9	2	0	3.00	42.00	2	-24.00	0.21	0.40	0	2	2	2	2	2	2	2	2	2
37	1	68	98.6	2.00	7.38	1.00	9	2	5	2.56	40.00	2	-8.00	0.40	0.60	2	2	2	2	2	2	1	2	2	2
38	1	66	98.0	5.60	7.35	1.30	9	2	0	3.14	38.30	2	-3.00	0.21	0.40	0	2	2	2	2	2	2	2	2	2
39	1	26	95.0	0.60	7.12	1.00	4	2	58	3.60	40.00	2	-12.00	0.70	0.90	8	1	1	1	2	1	2	2	2	1
40	1	66	97.0	48.00	7.38	1.60	8	2	0	3.30	40.00	2	-3.00	0.21	0.40	0	2	2	2	2	2	2	1	2	2
41	1	66	99.0	3.80	7.38	1.60	8	2	0	3.16	39.00	2	-4.00	0.21	0.40	0	1	2	2	1	2	2	2	2	2
42	2	25	98.0	2.30	7.52	1.00	9	1	42	1.36	32.00	2	-8.00	0.60	0.90	8	1	2	2	2	1	2	1	2	2
43	2	66	99.0	3.80	7.38	1.60	8	2	0	3.16	39.00	2	-4.00	0.21	0.40	0	1	2	2	1	2	2	2	2	2
44	2	26	95.0	2.22	7.16	1.10	8	2	29	3.00	37.00	2	-13.40	0.49	0.87	7	1	1	1	1	1	2	2	2	2
45	1	63	98.0	5.80	7.40	1.40	7	2	0	2.90	38.50	2	-3.00	0.38	0.29	0	2	2	2	2	2	2	2	2	2
46	1	48	97.0	1.50	7.20	0.80	8	1	22	1.40	36.00	2	-8.40	0.40	0.60	2	1	2	2	1	1	2	1	1	2
47	2	56	95.0	4.20	7.16	1.50	6	2	52	2.60	37.00	2	-7.90	0.50	0.67	4	1	2	2	2	1	1	1	2	2
48	1	45	95.7	3.80	7.20	1.70	8	2	8	2.40	36.50	2	-6.00	0.40	0.34	0	2	2	2	2	2	2	2	2	2
49	1	26	97.0	0.74	7.16	0.70	9	2	37	2.56	37.00	2	12.40	0.70	1.00	10	1	1	1	1	1	2	2	2	1
50	2	46	98.0	4.60	7.38	1.80	7	2	19	2.80	38.00	2	-6.00	0.21	0.40	0	1	2	2	2	2	1	2	2	2
51	1	65	98.0	4.70	7.36	1.50	8	2	0	3.20	38.00	2	-2.50	0.21	0.40	0	2	2	2	2	2	1	1	2	2
52	2	48	97.0	4.50	7.20	1.20	8	2	0	3.24	38.00	2	-4.20	0.30	0.40	0	2	2	2	2	2	1	2	2	2
53	2	70	97.0	1.60	7.22	1.40	5	2	23	2.60	34.00	2	-8.40	0.50	0.80	5	1	2	2	1	2	2	1	2	2
54	2	48	98.0	4.60	7.42	1.20	8	2	0	2.56	38.00	2	-4.60	0.30	0.40	0	2	2	2	2	2	2	1	2	2
55	2	3	95.0	0.60	7.12	1.00	7	2	58	3.60	40.00	2	-12.00	0.70	0.90	8	1	1	1	2	1	2	2	2	1
56	1	65	98.4	3.00	7.34	1.20	9	2	0	3.00	38.00	2	-2.00	0.21	0.40	0	2	2	2	2	2	2	2	2	2
57	2	68	98.6	2.00	7.38	1.00	9	2	5	2.56	40.00	2	-8.00	0.40	0.60	2	2	2	2	2	2	1	2	2	2
58	1	57	95.2	2.30	7.30	0.50	5	1	48	1.80	36.00	2	-7.90	0.50	0.83	6	1	2	2	2	1	1	2	2	2
59	2	25	98.0	2.30	7.52	1.00	9	1	42	1.40	32.00	2	-8.00	0.60	0.90	8	1	2	2	2	1	2	1	2	2
60	1	25	95.0	0.60	7.16	1.00	7	2	58	3.20	39.00	2	-11.00	0.74	0.90	8	1	1	1	2	1	2	2	2	1

61	1	76	97.0	4.80	7.40	1.70	9	2	0	3.00	42.00	2	-24.00	0.21	0.40	0	2	2	2	2	2	2	2	2
62	2	25	97.0	2.20	7.52	1.00	9	1	42	1.34	32.00	2	-8.00	0.57	0.89	8	1	2	2	2	1	2	1	2	2
63	1	68	98.6	2.00	7.32	1.00	9	2	5	2.56	40.00	2	-8.00	0.45	0.66	2	2	2	2	2	2	1	2	2	2
64	1	50	95.6	4.20	7.16	1.30	6	2	52	2.80	39.00	2	-8.20	0.54	0.65	4	1	2	2	2	1	1	1	2	2
65	1	65	95.8	2.30	7.20	0.90	4	1	40	1.70	34.00	2	-8.30	0.45	0.85	6	1	2	2	2	1	1	2	2	2
66	2	56	95.2	2.50	7.12	1.10	5	2	52	2.40	36.00	2	-7.80	0.49	0.67	4	1	2	2	2	1	1	1	2	2
67	2	64	98.0	5.60	7.35	1.70	9	2	0	2.70	39.00	2	-5.00	0.32	0.40	0	2	2	2	2	2	2	2	2	2
68	1	25	98.0	2.30	7.52	1.00	9	1	42	1.36	32.00	2	-8.90	0.64	0.90	8	1	2	2	2	1	2	1	2	2
69	1	56	98.5	3.50	7.40	1.70	9	2	0	2.90	37.50	2	-4.00	0.31	0.40	0	2	2	2	2	2	2	2	2	2
70	1	66	98.0	4.50	7.36	1.40	8	2	0	3.30	40.00	2	-3.00	0.21	0.40	0	1	2	2	2	2	2	1	2	2

Key to master sheet

Gender	1=Male, 2=Female
Small for gestational age	1=Yes, 2=No
Congenital malformation	1=Yes, 2=No
SIRS	1=Yes, 2=No
MODS	1=Yes, 2=No
Septic shock	1=Yes, 2=No
Sepsis	1=Yes, 2=No
AKI	1=Yes, 2=No
Seizures	1=Yes, 2=No
Hypoglycemia	1=Yes, 2=No
Hyperbilirubinemia	1=Yes, 2=No
Death	1=Yes, 2=No

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