# SNAP-II and SNAPPE-II:

**Simplified newborn illness severity and mortality risk scores**

***Thesis***

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# *Dedication*

*To the spirit of my **father**,*

*who gave me everything and took nothing.*

*To my **mother**,*

*who helped me in every step of my life.*

*To my **wife**,*

*who encouraged me to complete this work.*

*To my **son**,*

*who made my days to shine.*

*To my **family** and all my **friends**,*

*who helped me.*

*Aly*

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# CONTENTS

# List of tables

# List of figures

# List of abbreviations

| | |
|---|---|
| **APACHE** | **Acute Physiology and Chronic Health Evaluation** |
| **ALT** | **Alanine aminotransferase** |
| **APS** | **Acute Physiology Score** |
| **BUN** | **Blood Urea Nitrogen** |
| **$CO_2$** | **Carbon Dioxide** |
| **CPAP** | **Continuous Positive Airway Pressure** |
| **CRIB** | **Clinical Risk Index Of Babies** |
| **$FiO_2$** | **Fraction of inspired Oxygen** |
| **GCS** | **Glasgow Coma Scale** |
| **HIV** | **Human Immune deficiency Virus** |
| **HR** | **Heart Rate** |
| **ICU** | **Intensive Care Unit** |
| **INR** | **International Normalization Ratio** |
| **IQ** | **Intelligence Quotient** |
| **IU** | **International Unit** |
| **kPa** | **kilo Paskal** |
| **LODS** | **Logistic Organ Dysfunction Score** |
| **MBP** | **Mean Blood Pressure** |
| **MDI** | **Mental Development Index** |
| **mEq/L** | **Milli Equivalent per Liter** |

| | |
|---|---|
| **mmHg** | **Milligram per deciliter** |
| **mmol/L** | **Millimole per Liter** |
| **MODS** | **Multiple Organ Dysfunction Syndrome** |
| **MPM** | **Mortality Probability Model** |
| **NBRS** | **Neurobiological Risk Score** |
| **NICHD** | **National Institute of Child Health Development** |
| **NMPI** | **Neonatal Mortality Prognosis Index** |
| **NTISS** | **National Therapeutic Intervention Scoring System** |
| **P** | **Probability value** |
| **$PaO_2$** | **Partial Oxygen Tension In Arterial Blood** |
| **$PaCO_2$** | **Partial Pressure of Carbon Dioxide Tension** |
| **PMI** | **Psychomotor Development Index** |
| **PELOD** | **Paediatric Logistic Organ Dysfunction** |
| **PERI** | **Perinatal Risk Inventory** |
| **PHI** | **Prehospital Index** |
| **PICU** | **Paediatric Intensive Care Unit** |
| **PRISM** | **Paediatric Risk of Mortality** |
| **PRISM APS** | **Paediatric Risk of Mortality Acute Physiologic Score** |
| **PSI** | **Physiology Stability Index** |
| **PT** | **Prothrombin Time** |
| **PTS** | **Paediatric Trauma score** |

| | |
|---|---|
| **PTT** | **Partial Thromboplastin Time** |
| **ROC** | **Receiver Operating Characteristics** |
| **ROM** | **Risk of mortality** |
| **RR** | **Respiratory Rate** |
| **SAPS** | **Simplified Acute Physiology score** |
| **SBP** | **Systolic Blood Pressure** |
| **SD** | **Standard Deviation** |
| **SIRS** | **Systemic Inflammatory Response Syndrome** |
| **SNAP** | **Score for Neonatal Acute Physiology** |
| **SNAP-II** | **Score for Neonatal Acute Physiology, version II** |
| **SNAPPE** | **Score for Neonatal Acute Physiology- Perinatal Extension** |
| **SNAPPE-II** | **Score for Neonatal Acute Physiology- Perinatal Extension, version II** |
| **SOFA** | **Sepsis-Related organ Failure Assessment Score** |
| **SOI** | **Severity of Illness** |
| **SGA** | **Small for gestational age** |
| **UK** | **United Kingdom** |
| **US** | **Ultrasound** |
| **WBCs** | **White Blood Cells** |
| **µmol/L** | **Micro mole per liter** |

# Abstract

The measurement of illness severity and mortality risk is essential to making fair comparisons of outcomes among hospitals and routinely available markers of risk such as birth weight, gestational age, and sex do not adequately capture the dimension of illness severity. Scoring systems are a means to quantify clinical states that are difficult to summarize by other subjective or objective means. The desirable properties of neonatal scores are not much different in essence from those required for scores used in paediatric population. This properties have been described as including: (1) ease of use; (2) applicability early in the course of hospitalization; (3) ability to predict mortality, specific morbidities; and (4) usefulness for all groups of neonates to be described.

So SNAP-II and SNAPPE-II developed as a simple neonatal illness severity and mortality risk scores.

**Key Word :** SNAP-II and SNAPPE-II **-** illness severity and mortality risk scores **-** newborn.

# INTRODUCTION

Scoring systems and risk prediction rules quantitate the severity of clinical conditions and stratify patients according to a specified outcome. In intensive care medicine , the complexity and number of clinical scoring systems is increasing as the utility in both health services research and clinical medicine broadens. We anticipate that the increasing health care costs and competition and the demand for risk adjusted outcomes will increase. As academicians and clinicians , it is vital to be knowledgeable regarding the methodologies and application of these scoring and risk prediction systems to insure their quality and appropriate utilization (**Marcin et al.,2000).**

Current healthcare economics require large investments for establishing ICUs. It is important for developing countries to evaluate the benefit from having costly ICUs and to ensure the most cost-effective use of their limited resources without compromising the quality of care ( **Ozer et al., 2004).**

To achieve cost-effectiveness, health service researchers have been investigating differences in structure, processes and outcomes of medical care (quality and cost ) to identify “best practices”. Accurate, reliable conclusions about “best practices” often require clinical scoring systems designed to objectively measure clinical status, severity of illness (SOI), or risk of a specified outcome (**Marcin et al .,2000).**

Scoring systems are a means to quantify clinical states that are difficult to summarize by other subjective or objective means. These systems are especially valuable in the ICUs, where subjective impressions of clinical states, severity of illness (SOI), and risk of mortality are highly variable ( **Ozer et al., 2004).**

Routinely available markers of risk such as birth weight, gestational age, and sex do not adequately capture the dimension of illness severity **(Maier et al.,2002).**

The desirable properties of neonatal scores are not much different in essence from those required for scores used in pediatric population. This properties have been described as including: (1) ease of use; (2) applicability early in the course of hospitalization; (3) ability to predict mortality, specific morbidities; and (4) usefulness for all groups of neonates to be described **(Dorling et al., 2005).**

Score for Neonatal Acute Physiology (SNAP) was developed in 1990. It is based on 28 items collected over the first 24 hours of admission in NICU . Birth weight < 1000 grams, small for gestational age" weight < 3rd percentile for gestation", and Apgar score at 5 minutes(< 7) were added to the original SNAP to develop SNAP-PE (SNAP -PERINATAL EXTENSION). The major problem with this 28 variables score is the difficulty to collect. A second generation of SNAP and SNAPPE (SNAP-II and SNAPPE-II) which would be:

1. Simpler: by reducing the number of score items.
2. More reliable**:** by eliminating score items that are complex or difficult to define and abstract.
3. Empirically weighted**:** by deriving the score empirically so that score items reflect actual mortality risk rather than the original clinician estimates **(Dorling et al., 2005).**

# AIM OF WORK

The aim of this study is to assess the efficiency of The Score for Neonatal Acute Physiology, Version II (SNAP-II) and The Score for Neonatal Acute Physiology-Perinatal Extension, Version II (SNAPPE-II) as a simple neonatal illness severity and mortality risk scores.

## Development of Scoring Systems

There has been an enormous increase in the number and the complexity of clinical scoring systems and their use in research and patient care. In paediatrics, it has been a revolution from the time of the Apgar score in 1953 to current scoring systems **(Dorling et al ., 2005).**

Although it may be possible to derive a risk adjustment score in a particular study, investigators will often require a readymade score. They may lack the data, resources, time, funding, or expertise required to develop their own score. A previously validated score also has the advantage that it is more likely to be accepted by others. The choice of which variables are to be included in the score and their relative weights is obviously vital. A balance needs to be drawn between a complex score including many variables, and therefore difficult to complete, and a simpler model that may be easier to use but not as accurate. It also needs to be remembered that no score can completely quantify the complex factors that make up an individual child's morbidity ( **Shann,2002).**

Usually, scores are created in one of two ways ''**M**edical'' scores are derived by an expert panel using clinical knowledge to select the variables to be included in the score and their relative weights. Alternatively, collected data are used in statistical models to produce ''**S**tatistical'' scores by identifying which variables have strong association with the outcome of interest and their relative weights. There is evidence that, in the long run, statistical scores outperform purely medical scores and today most scores are statistical as there are often relevant data available. However, clinical knowledge should indeed contribute to the choice of variables included in a final model; not just because the model is then likely to perform better with other groups of children but because it will be seen as more reliable by users **(Dorling et al ., 2005).**

However the score is derived, it is important that it has been validated to confirm that it predicts future events, preferably in a different dataset, with an adequate accuracy (calibration). It is important to remember that, for the score to be clinically useful, the predicted and observed event rates should closely match (**Altman et al ., 2000).**

Despite the large volume of literature describing different scoring systems and their uses, not much has described how these systems are developed.

First the objective of the scoring system is defined, followed by data collection, statistical analysis of data, and finally validation **( Adlam et al ., 2005).**

## Definition of objective

The development of a successful scoring system requires clear, easily defined, and relevant outcome variables; adherence to well-defined methodological standards; and a clear objective. The clear objective of the scoring system and its proposed use will determine whether predictor variables are selected for being simple and cost-effective (as for scores used in emergencies) or for optimum statistical accuracy as in the more complex scores( **Greenland et al., 1989).**