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SpO_2/FiO_2 ratio (SF ratio) as a predictor of mortality in ICU patients: Retrospective study using MIMIC Database.

Ahmed Gobba

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Supervised by: Willem Van Den Boom
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Background Information

1.1 Introduction

Allocation of resources to critical care patients to minimize mortality is a priority for healthcare professionals. As such the search for connections between various physiological indicators and unfavourable outcomes such as extreme illnesses or even mortality is a constant priority of researchers. One such pulmonary physiological indicator is the PaO_2/FiO_2 ratio (PF ratio). PaO_2 refers to the partial pressure of oxygen in arterial blood and is measured in mmHg via drawing a sample of blood from an artery in the wrist, that then is tested in a laboratory. FiO_2 refers to the initial fraction of inspired oxygen and is approximately 21% in breathable atmosphere and can be controlled with the use of mechanical ventilation.The PF ratio is importantly used in the diagnosis of extreme illnesses such as Acute Respiratory Distress Syndrome (ARDS) and has been shown to be predictor of mortality in specific subsets of patients such as newborns with Meconium aspiration syndrome (MAS) (Narayanan et al., 2019).

However, there are challenges associated with measurement of PaO_2

specifically. Most importantly, the procedure is invasive and as such is not easy to measure for all patients and to track at frequent intervals. A more convenient value to measure however is SpO_2 or peripheral capillary oxygen saturation, an estimate of the amount of oxygen in the blood. It is measured using pulse oximetry, a noninvasive method for monitoring a person's oxygen saturation. Moreover, SpO_2/FiO_2 ratio ratio has been shown to be a non-invasive surrogate for PaO_2/FiO_2 ratio to diagnose subsets of patients such as children with ALI or ARDS (Rice et al., 2007) and burned children with smoke inhalation injury (Cambiaso-Daniel et al., 2017).

A retrospective study found that the SpO_2/FiO_2 ratio Time-at-Risk (SF-TAR), defined as the total time spent with severe hypoxemia (SF ratio $\leq$ 145), is not only significantly correlated with hospital mortality for mechanically ventilated patients, but is as well or a better predictor of it than arterial gas-derived measurements of the PF ratio.

Moreover, there have been several studies that aim to link SpO_2 to mortality. In 2015, the Tromsø study concluded that an $SpO_2 \leq 95\%$ is associated by all-cause mortality and mortality caused by pulmonary diseases (over a 10-year follow-up period) after adjusting for sex, age, history of smoking, self-reported diseases and respiratory symptoms, BMI, and CRP concentration. When Forced Expiratory Volume (FEV1) was included as a covariate, the correlation remained significant for mortality due to pulmonary diseases but no longer significant for all-cause mortality (Vold et al., 2015).

However, a prospectively planned meta-analysis participant data from 5 randomized clinical trials (conducted from 2005-2014) of infants born

before 28 weeks' gestation period found no significant difference between a lower SpO_2 target range (85%-89%) and a higher SpO_2 target range (91%-95%) on mortality or major disability at a corrected age of 18 to 24 months (Askie et al., 2018). Therefore, it seems that the use of SpO_2 as a predictor of mortality might not be applicable to all patient phenotypes, with a possibility of further sub-phenotyping.

1.2 Aim and Objectives

The main goal of this Capstone can be summarized in the following statement:

Investigate whether SpO_2/FiO_2 ratio is a statistically significant predictor of mortality in general ICU patient population or subsets thereof using a retrospective analysis of data.

The use of SpO_2/FiO_2 ratio instead of solely SpO_2 allows us to account for the different levels of mechanical ventilation that an ICU patient receives. In essence, it allows us to account for the patient's ability to convert inspired oxygen to peripheral oxygen saturation at the tissue level.

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Appendix A

None