Comorbidities Associated with Poor Survival among Adult ICU Patients

Who are Discharged Home

**Abstract:**

**Key Words:** Survival Analysis, Comorbidity Scores, mortality, MIMIC-III Database

**Introduction**

The mortality of critically ill patients has been studied from many different perspectives. Some focuses on a certain health condition, for example trauma[] or heart diseases []. Some focuses on the impact of a certain factor on the mortality, such as the impact of obesity [], or gender [].

As with the previous studies, we present this study from another different perspective. In this study, we aim to find the mortality risk indicators to help doctors reevaluate their patient discharge decisions in hope of reducing mortality rate among patients who are sent home after their stay in the hospital. Patients are discharged to different locations such as SNF (skilled nursing facilities), hospice, long-term care hospitals, rehabilitation facilities, home, etc. based on doctors’ judgement of the patients’ health condition at the end of their stay in the hospital. It is reasonable to assume that patients who were sent home were considered as being in a stabilized condition and able to maintain the status-quo or recover on their own without further medical assistance except for medications. However, there are cases where the patients who were sent home died within 90 days of discharge from the hospital. It would be helpful to identify signs of high mortality risk for patients who are originally considered to be qualified for recovering at home, so that it may help the doctors reevaluate their discharge decisions and lower the mortality rate among patients who are sent home.

Besides the patient demographic information, insurance, admission type, last ICU unit the patient was in, and the length of stay in the hospital, we are particularly interested in investigating the impact of comorbidity scores and vital signs on the mortality.

**Data Source**

The data used in this study are from the MIMIC-III (**M**edical **I**nformation **M**art for **I**ntensive **C**are III) database where all patients have been admitted to one or more Intensive Care Units (ICU) at the Beth Israel Deaconess Medical Center in Boston, Massachusetts between 2001 and 2012. This database is publicly available, and the patient records are fully deidentified. [freely accessible database]

This study focuses on adult patients and their condition at the end of their hospital stay. Therefore, patients who are below the age of 18 at the time of being discharged from the hospital are excluded from this study. Patients who stayed in the hospital for one day or less, who died in the hospital or within one day of being discharged from the hospital, and those who were discharged to Hospice or hospice equivalent facilities are also excluded. After applying these criteria, there are 11,067 patients who were sent home, and 30,111 who were discharged elsewhere.

**Data Preprocessing**

All date variables are masked in the same fashion to deidentify the patients. We used the difference between the date of discharge and the date of birth as the age at time of discharge from the hospital. Since age may not exhibit a linear relationship with the mortality rate especially with the presence of other variables, we grouped the age variable into 4 intervals (adults, middle aged, aged, aged – 80 and over) based on the MeSH (Medical Subject Headings) age groupings. Due to the same reason, we grouped the hospital length of stay into intervals as well as the number of doctor notes for each patient. Categorical variables such as marriage status, ethnicity, language and religion are also grouped to reduce dimensionality and to balance the sample size of each category while keeping the new groups meaningful.

Previous research suggests that oxygen saturation plays a role in the assessment of critically ill patients. []. We took the O2 Saturation Pulseoxymetry, Mixed Venous O2% Saturation, and Central Venous O2% Saturation as the vital signs that could have a significant impact on mortality. There are a very small number of outliers (51 out of 2,682,598) where the measurement values are much greater than 100. These outliers might have been caused by erroneous data entry since these values, as their names suggest, are percentage of oxygen concentration in the blood of different parts of the body, and thus they are supposed to be no greater than 100. In addition, many patients were measured repeatedly for the same type of measurement, and some were measured for multiple types of measurements. Since we are interested in the health condition of the patients at the time of discharge, we only kept the latest measurement for each type of measurement. Since not all patients had oxygen levels measured, we imputed the missing values by xxxxx.

**Survival Analysis**

This is a typical survival analysis problem where the beginning of the study period is the time when the patient is discharged from hospital, and the end of the study period is 90 days after discharge. Patients who died after 90 days of discharge and those who survived the entire study period were censored. The study period was defined to be 90 days because the patients who were admitted to the hospital after 2008 were followed up for a maximum of 90 days after being discharged from the hospital. Although those who were admitted before 2008 were followed up for a maximum of 4 years after discharge, to make it consistent for all patients, we take the shorter follow-up period of the two as the study period.

The Cox Proportional Hazard model was used to perform the survival analysis because this model allows multiple variables to be analyzed for their effects on the hazard (i.e. the probability of dying) [statistics review]. In order to reduce the potential bias on the estimated effect size of each variable caused by not including all underlying variables of the true model while keeping the dimensionality low, we started with investigating variables that are likely to be significant based on our judgement, previous research, and the accessibility of the data. These variables include demographic information such as age, gender, ethnicity, language, religion, insurance, and marriage status, general information such as insurance, admission type, the last ICU unit, and other information such as the number of medical notes and the length of hospital stay.

Backward selection

**Survival Analysis**

1. **Original variables**
2. **With ICU data**
3. **With number of diagnoses under each ICU major category**
4. **With Charlson Comorbidity Scores**
5. **Patients who were discharged to home.**

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**Discussion**

**Future Work:**

**Some studies analyzed doctor notes by**

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