**Literature Review: Predictive Modeling of In-Hospital Mortality Following Elective Surgery**

**Introduction**

One of the main important things that can reveal patient risk factors, surgical success, quality of care is In Hospital Mortality after Elective Surgery. As there is an increase in surgical complexity and patient population, forecasting the unfavourable outcomes, optimizing resource allocation, including in hospital mortality became a focal point in health care research. In order to lower death rates and to enhance risk prediction, recent research have investigated a variety of factors impacting perioperative mortality and have used a variety of approaches, such as sophisticated statistical and machine learning models.

**Key Predictive Factors and Associations**

According to **Wan et al (2021)**, postoperative infections are a major contributor to higher mortality and complications following elective procedures. They have identified a total of 4032(44814 patients) infections in 2927 in which 737 infections were severe. They observed most frequent infections as surgical-site (1320, 32.7%), pneumonia (708, 17.6%), urinary tract infection (681, 16.9%), antimicrobials (2126 of 2749 77.3%).   
**Factors:** Age, gender, ASA grade, preoperative anaemia, anaesthetic technique, surgical category, etc.   
**Conclusion:** Infection increased risk of death and duration of hospital stay by avg 6.45%. By recognition of this – It will help to create appropriate prevention strategies.  
  
**Nathaniel R. Smilowitz (2021)** research says that Heart failure (HR) affects nearly 5.7 million adults in US. It is recognized to be associated with increased risk of complications after non-cardiac surgery. In their statistical analysis – Linear regression – Standard error of measurement, Multivariable – Logistic regression which identified factors like Age, sex, tobacco use, obesity, hypertension, diabetes, coronary artery disease, drug & alcohol usage, anaemia, percutaneous coronary intervention (PCI). In their analysis of large US database, 49% of hospitalizations for non-cardiac surgery were associated with a diagnosis of HF, these patients had higher risk of mortality.

**Cabrera, A(2024)** used 3 ML algorithms to predict the in hospital mortality among patients with Ankylosing Spondylitis(AS) or Diffuse Idiopathic Skeletal Hyperostosis(DISH). They stated that finding these mortality causes may serve to provide physicians with an awareness of risk factors for in-hospital mortality and subsequently guide management to share decision making among patients with AS & DISH. The algorithms they have used are Random Forest classifier, Gradient Boosting classifier and Adaptive boosting classifier which had an avg accuracy of 87.52%.

**Miyake et al. (2020)** study explores the relationship between pre-operative chronic kidney disease (CKD), acute kidney injury (AKI), and in-hospital outcomes. They found that patients with pre-operative AKI had significantly increased mortality regardless of CKD factors. AKI was associated with increased use of vasoactive drugs, mechanical ventilation, blood transfusions and post operative renal replacement therapy.   
Also the length of stay was longer for patients with AKI or severe CKD  
One important finding is that, early identification and intervention for AKI to mitigate mortality and complications post-surgery.

**Castro-Dominguez et al. (2021)** research on PCI (706236) at 1608 sites highlighted the factors like procedural urgency, cardiovascular instability, level of consciousness after cardiac arrest were some of the factors contributing to in hospital mortality (1.91%). Their model – multivariate logistic regression which was used for 70% model development (495005 – 1608 sites – mortality of 1.91%) and 30% model validation (211258 – 1606 sites – mortality 1.93%) can be used to improve clinical decision-making and optimize resource allocation in high-risk population.

**Kassahun et al (2024)** – study on chronic obstructive pulmonary disease impact (COPD) and outcomes of acute abdominal diagnosis states that patients with COPD had higher mortality and longer hospital stays with extended ventilation post-surgery – these also contributed in respiratory and cardio vascular outcomes after surgery.

**Conclusion**

The predictive modeling of mortality in hospital after elective surgery has proved to be efficient in identifying the risk of mortality for patients undergoing different surgery and identifying factors that effect their mortality, these findings will serve physicians to be aware of risk factors and guide management to share decision making. Some of the researches above have stated that clinical applications of associations are limited by several methodologic considerations. As you can see in the above mentioned articles, there are many factors that contribute to the in hospital mortality, In our research, we would like to identify risk factors, based on our dataset – we would like to provide insights about the underlying conditions that led to mortality in different facilities located throughout the US (as our dataset contains complications and deaths happened from 3rd quarter since 2020 all across the US) . In this research we would inculcate multiple machine learning models to measure the performance of each model, their accuracy, provide useful in-sights from our data and to make valuable conclusions.

Future work should focus on developing models using an inclusive multiple-center approach of data to increase prediction accuracy and applicability across populations. Also, improvements in transparency and interpretability will allow machine learning algorithms to become more applicable and integrated with clinical practice. All these developments fill predictive modeling with great potential to tackle surgical outcomes, reduce in-hospital mortality, and improve patient safety.

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