Agenda

• AI-based Prediction for Post-Surgical Complications in Patients Undergoing Elective Surgery by Singapore A*STAR
AI-based Prediction for Post-Surgical Complications Risk in Patients Undergoing Elective Surgery

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PROBLEM

300 million surgeries per year around world

~ 5% post-operative mortality

~ 15% post-operative complications

Reference:
2. Postoperative complications and implications on patient-centered outcomes: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3637983/
A decision support tool for surgeons to predict post surgery complications of elective surgery patients using pre-operative clinical risk factors.
**DATA OVERVIEW**

**VitalDB**

- The VitalDB (Vital Signs DataBase) for surgical patients.
- Routine operation at Seoul National University Hospital, Seoul, Korea.
- 4,221 patients with non-emergency surgery performed (elective surgery).

<table>
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<th>Age</th>
<th>n</th>
<th>Mean</th>
<th>Std</th>
<th>Min</th>
<th>25%</th>
<th>50%</th>
<th>75%</th>
<th>Max</th>
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<td>58.6</td>
<td>14.2</td>
<td>0.6</td>
<td>50.0</td>
<td>60.0</td>
<td>69.0</td>
<td>90.0</td>
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</table>

No. of Cases in VitalDB
N = 6,388

Non-emergency Cases
N = 5,606

Cases with pre- and post-operative lab biomarker data
N = 4,221
To predict post-surgical risk complications, our study defines these complications as:

- In-hospital mortality
- Duration of ICU stays 2 days or more
- Post-operative acute kidney injury (AKI)
**MODEL RESULTS - FROM XGBOOST FEATURE SELECTION MODEL**

**XGBoost Gradient Boosting Classifier**

**Top 3 Risk Predictors**

- Any Transplantation
- Perioperative C-reactive Protein
- Perioperative Platelet Count

![ROC Curve (AUC=0.8903)](image)
First Tier Model

4 Features for Predictors of Post-Surgical Risk

- Any Transplantation
- Perioperative C-reactive Protein (High)
- Perioperative Platelet Count (High)
- Perioperative Fibrinogen (Low)
OPTIMUM MODEL RESULTS - FIRST TIER MODEL

4 Features for Predictors of Post-Surgical Risk

- Increase the risk of Surgical Site Infections
- Entails longer hospital durations

- CRP serves as a well-established marker of inflammation
- High CRP indicates presence of inflammatory response
- Leads to complications such as infections, cardio events and prolonged hospital stays

Reference:
OPTIMUM MODEL RESULTS - FIRST TIER MODEL

4 Features for Predictors of Post-Surgical Risk

- Platelets are cells that helps the blood clot
  - High preoperative platelet count:
    > Increases the likelihood of thrombotic events
    > Can be worsened by surgery

- Fibrinogen is a protein that helps to stop bleeding and support wound healing
  - Low levels of fibrinogen:
    > Leads to uncontrollable bleeding
    > Increase the risk of AKI, indicating hepatic dysfunction

Reference:
OPTIMUM MODEL RESULTS - SEQUENTIALLY CONSTRUCTED USING TOP PREDICTORS

Second Tier Model

ROC Curve (AUC=0.8487)

17 Features for Predictors of Post-Surgical Risk

- Any Transplantation
- Perioperative C-reactive Protein
- Perioperative Platelet Count
- Perioperative Fibrinogen
- Age
- Perioperative Sodium
- Perioperative Glucose
- Perioperative White Blood Cells
- Perioperative Haematocrit
- Perioperative Glomerular Filtration Rate
- Body Mass Index (BMI)
- Perioperative prothrombin percentage time
- Perioperative Alanine Transferase
- American Society of Anaesthesiologists Physical Status Classification Grade 2
- Perioperative Total Protein
- Perioperative Creatinine
- Perioperative Blood Urea Nitrogen
To perform ML validation with 4 external datasets:

1. Singapore Perioperative Dataset, Singapore General Hospital, Singapore
2. INSPIRE, publicly available research dataset in preoperative medicine, Seoul National University Hospital, Seoul, South Korea
3. OHDSI Thailand's Electronic Health Records with Perioperative Data (in discussion with Max)
4. OHDSI Data partners
PLANS TO MOVE FORWARD

ML Development
• ML paper on development of Asian predictive model (A*STAR/NUS/NUH collaboration) at the SHADE'22 Datathon

ML Validation
• ML validation with external datasets at the OHDSI APAC Symposium 2024

ML Validation
• ML validation with MOH TRUST (Whole of Singapore EHR) in 2025
Thank you!