Solution Design and Model Architecture

Ideation:

UNEXPLORED GAPS IN MEDICAL CARE AND TREATMENT ADVICE

A “Gap in medical care” is defined as the discrepancy between recommended best practices and the care that is actually provided. Health disparities in the quality of health care are due to lack of access related factors or clinical needs, preferences, and appropriateness of intervention.

As per research, medical errors are one of the leading causes of death in India and also across the world.

Right treatments as per the best practice can help improve health outcomes.

What is being currently done?

System level measures:

- Expand access to insurance coverage.
- Closing socio-economic gaps by offering greater access to preventive care.
- Easier access to pharmaceutical meds (via discounts) to those people that fall way below the poverty line.

Local level measures:

- Analyzing health outcomes based upon various factors such as race, age, and gender, and correlate them with geographic location.
- Targeting the realms of need and the intervention types that are required in your area.
- Organizations providing funds for research that compares different approaches to care in order to find the fit best in various types of scenarios and different population groups.

Micro-level measures:

- Instituting technology solutions such as telemedicine and electronic communication to provide ongoing care for patients who may live far away, or who might not have easy access to transportation.
- Making the health record more portable for patients so that they can better engage in their care.

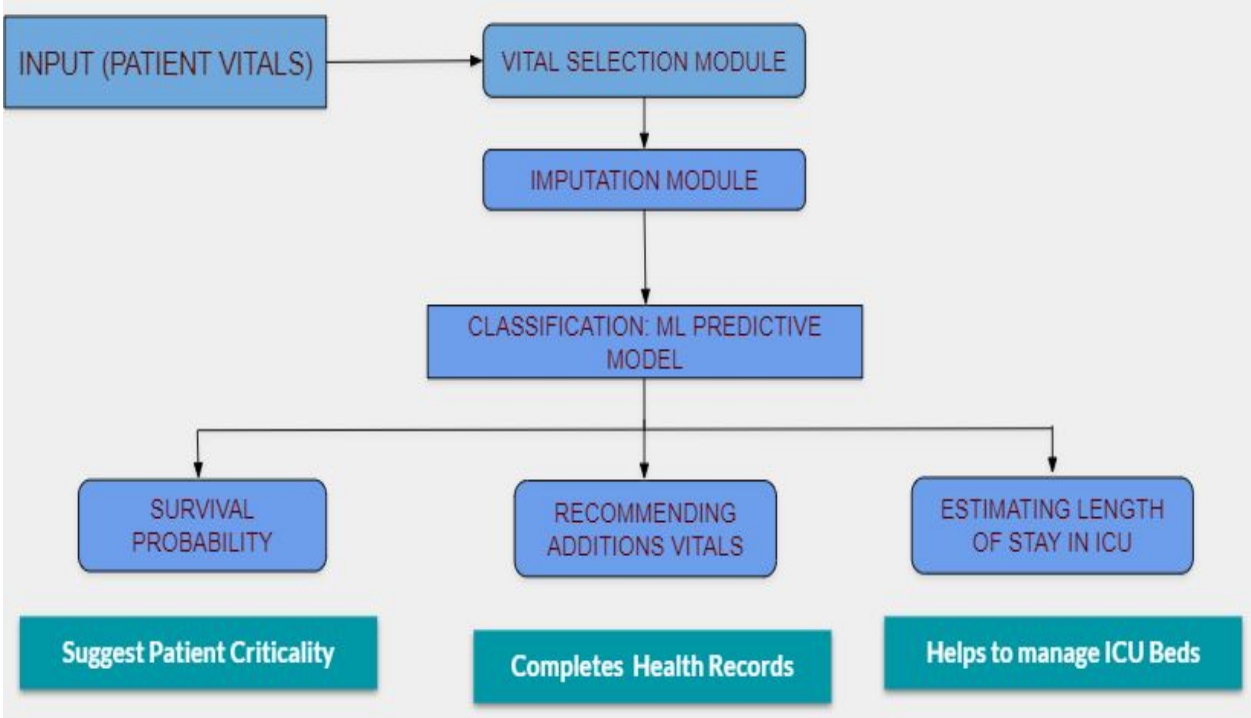
Proposed Product for solution:

CAREVIS : Aiding the ones who save us

An AI based treatment advice system (that can recommend the medical practitioner with the right additional parameters to keep track of in order to improve the **probability of survival** and estimates the **length of stay** in ICUs).
India's health care delivery mechanism is defined by shortcomings; the doctor-patient ratio is skewed, over 75 per cent of India's population has no health insurance.
Predicting probabilities of the survival for in-hospital mortality will help us build a rank-based system to help the medical practitioners prioritize the treatment of critical patients over the non-critical ones which would decrease the mortality rate in the hospitals. Along with that, we would also be suggesting additional vitals to be kept track off allowing the nursing professionals to maintain a propitious health record of the patients which indirectly improves the probability scores.
Also, in India there is a shortage of two million hospital beds compared with the global requirement of 2.5 beds per 1000 people and the spending on health is abysmally low at a little over one per cent of the GDP.
Estimating the Length of Stay of the patients in Intensive Care Units (ICUs) using advanced regression models of machine learning would help us chalk out the admission cycles of the new patients and plan the management of beds in a sustainable way.
The above model can also be extended to contribute to the government's plan of action in managing the beds of the ICUs for the current COVID-19 pandemic crisis* by having suitable insights from pre-trained models.

[*Since we did not have the data related to this pandemic, chalking out a plan for this crisis using the model is out of scope for this prototype, but can be extended if we have the data]

MODEL ARCHITECTURE



Input (Patient Vitals) :
We input the data instance of a patient to be ranked on our recommendation system in a CSV file which is read on our Flask App. Data includes personal information eg: Age, Gender, Height, Weight etc, or temporal vitals such as Cholesterol, Blood Pressure, Heart rate, Glucose etc. There are a total of 45 features in our model. (You can refer DataModel.pdf for more details).

Vital Selection Module:
Feature selection was based on Recursive Feature Elimination, coefficients of vitals in Logistic Regression as well as Random Forest feature weights. Module is serialized in mif.pkl file.

Imputation Module:
We used Iterative Imputation from MICE technique in sklearn since in our data each feature can be modeled as a function of other features. Object fitted on our data has been serialized in impute.pkl file.

Predictive Models:

- **Survival Probability:** We built a binary classification model which predicts the patient's mortality and the probability of the surviving/deceased class for the given vitals.

This model has been trained on data wherein it has been prerecorded whether patient has survived or not.
XGBoost and Random Forest was found suitable on the testing class.
Metrics selected was **ROC-AUC** curve and **F1 score**.

- **Length of Stay** (LoS)**:** A regression model was built which estimates the number of days between the patient's admission to the ICU and the end of hospitalization.

Decision Tree Regressor and Extra Decision Tree Regressor proved to be fruitful in this estimation.
This was a prerecorded data which had noted the LoS during patient's stay and models were trained on this target variable.
Metrics selected was **Mean Average Percentage Error (MAPE).**

Note:
Apart from these two Outcomes from our Model, we also suggest additional vitals to the nurse/compounder which may not have been recorded in the first place.

Also, this Data collection strategy and models, if executed over the years would generate millions of data points which would provide some actionable insights such as:

- Severity of the Disease over time.
- Effects on variation of vitals for a given disease.
- Mortality Rate Fluctuations over different locations for a period of time.
- Doctor's Success Rate
- Duration of treatment for a given disease

CLOUD ARCHITECTURE
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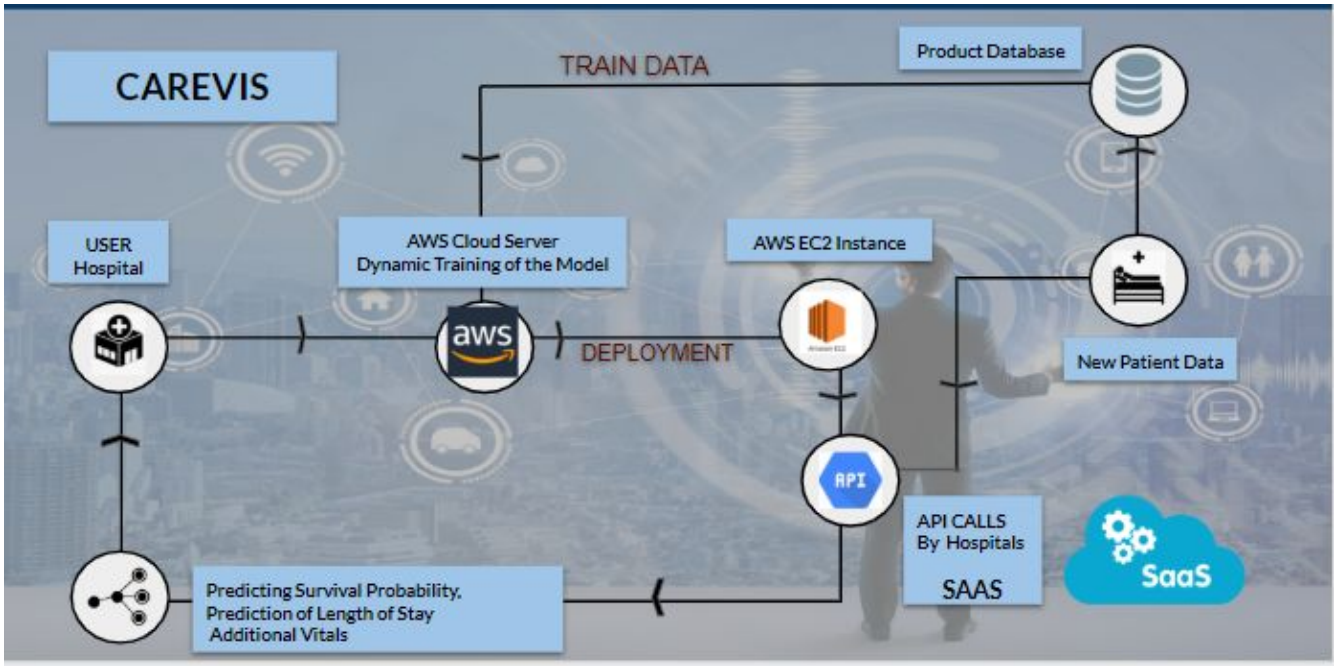

WORKING OF CLOUD

The Hospital(USER) is given a webapp with login, a similar webapp as our deployed model. In that webapp, which is simply a SaaS platform, they input the patient's data either manually or through their database which will be connected to their webApp to predict the survival probability and Length of Stay of the patient in the ICU. Additionally, we'll store this data to dynamically train our model, increasing our efficiency and developing a moat for our service.

Webapp: http://ec2-100-27-2-78.compute-1.amazonaws.com:5000/

India’s one of the biggest concerns is their Health Care System. We rank last with 154 out 195 countries in the Healthcare Index. More Indians Die due to poor quality care than due to lack of access to Health Care. Fig 1 present the current scenario of Healthcare System in India: