Hospital Mortality Prediction

Suggest the probable business impact of each independent feature on the target

1. Group: The preferred groups of patients in the ICU. (Medium)
    - Group in here may be referred to the level of intensive care
    - A level 1 ICU is capable of providing oxygen, noninvasive monitoring, and more intensive nursing care than on a ward
    - Whereas a level 2 ICU can provide invasive monitoring and basic life support for a short period.
    - **The level of ICU highly depends on the severity of heart disease and may not necessarily be correlated with mortality rate.**
    - By analyzing the dataset we can shift critical patients to level 2 ICU and reduce the mortality rate.
2. ID: Unique IDs of the patient. (No Affect)
    - **Doesn't play any role in predicting the mortality rate as each value is unique and there is no correlation with the target varable.**
3. Age: Age of the patient (High)
    - Older people are more likely to suffer a heart attack, or develop heart disease.
    - **Age may have high correlation with mortality rate.**
    - By analyzing the dataset we can provide extra care to old age patients and reduce the mortality rate.
4. Gender: Gender of the patient (Medium)

- Men generally develop cardio vascular disease at a younger age and have a higher risk of coronary heart disease than women.
- **Gender may influence chances of heart disease but may not necessarily be correlated with mortality rate.**
- Hospital should give equal importance to both the gender in care and service.

5. BMI: Body Mass Index of the patient (kg/m2) (Medium)
   - Obesity, assessed using body mass index (BMI) >30 kg/m2, is an established risk factor for development of coronary heart disease in healthy individuals.
   - **BMI may increase chances of heart disease but may not necessarily be correlated with mortality rate.**
   - By analyzing the dataset we can provide extra care to high BMI patients.
6. Hypertensive: Simply it suggests about the Blood Pressure of the patient, whether person is having that problem or not. (Medium)
   - High blood pressure can damage your arteries by making them less elastic, which decreases the flow of blood and oxygen to your heart and leads to heart disease.
   - **Hypertension may increase chances of heart disease but may not necessarily be correlated with mortality rate.**
   - By analyzing the dataset we can provide extra care to Hypertensive patients.
7. Atrial fibrillation: Irregular or rapid heart rhythm which caused to blood colts in heart. (Medium)
   - If your atrial fibrillation is persistent, it may start to weaken your heart. In extreme cases, it can lead to heart failure, as your heart is unable to pump blood around your body efficiently.
   - **Atrial fibrillation may be a result of heart disease but may not necessarily be correlated with mortality rate.**
   - Pateints having frequent atrial fibrillation can be given extra care
8. CHD with no MI: Coronary Heart Disease with no Myocardial Infraction(Heart attack). (Medium)
   - Coronary heart disease is a major cause of death worldwide.
   - **CHD with no MI may not necessarily be correlated with mortality rate.**
   - Patients having CHD with no MI can be given extra care.
9. Diabetes: Signifies the Sugar level in the blood (Medium)
   - Over time high blood sugar can damage blood vessels and the nerves that control your heart. People with diabetes are also more likely to have other conditions that raise the risk for heart disease.

- **Diabetes may increase chances of heart disease but may not necessarily be correlated with mortality rate.**
- Patients having diabates can be given extra care and asked to follow a diet plan with minimal or no addded sugar to imporve heart health.

10. Deficiency Anemia: Lacking of RBC (Medium)
    - When there's a low level of oxygen in the blood, the heart works extra hard to compensate. This puts a lot of pressure on the heart, which can cause it to beat faster, irregularly, and experience pain.
    - Untreated anemia can exacerbate underlying cardiovascular issues.
    - **Deficiency Anemia may increase chances of heart disease but may not necessarily be correlated with mortality rate.**
    - Patients having deficiency anemia can be given extra care.
11. Depression: In simple words it is tension/ some things which bothers a person. (Medium)
    - When you experience depression, anxiety or stress your heart rate and blood pressure rise, there's reduced blood flow to the heart and your body produces higher levels of cortisol, a stress hormone. Over time, these effects can lead to heart disease.
    - **Depression may increase chances of heart disease but may not necessarily be correlated with mortality rate.**
    - Patients dealing with depression can be given counselling to imporve heart health.
12. Hyperlipemia: Signifies whether body is having high level of lipids, cholesterol or not. (Medium)
    - Hyperlipidemia (high cholesterol) is an excess of lipids or fats in your blood. This can increase your risk of heart attack and stroke because blood can't flow through your arteries easily.
    - **Hyperlipemia may increase chances of heart disease but may not necessarily be correlated with mortality rate.**
    - Patients having hyperlipemia can be given extra care and asked to follow a diet plan with minimal or no oil intake to imporve heart health.
13. Renal Failure: When kidney losses their ability to filter wastes or waste product and ultimately it is going to accumulate. (Medium)
    - When the kidneys don't work well, more stress is put on the heart. Heart needs to pump harder to get blood to the kidneys. This can lead to heart disease
    - **Renal Failure may increase chances of heart disease but may not necessarily be correlated with mortality rate.**
    - Patients having renal failure can be given extra care.

14. COPD: Chronic Obstructive Pulmonary Disease i.e., chronic inflammatory lung disease that causes obstructed airflow from the lungs. (Medium)
    - COPD can bring persistent coughing, mucus production, wheezing, shortness of breath and chest tightness. Symptoms often worsen over time.
    - Severe COPD can have harmful effects on the heart, decreasing its ability to pump blood effectively.
    - **COPD may be a result of heart disease but may not necessarily be correlated with mortality rate.**
    - Patients having COPD can be given extra care.
15. Heart rate: Tells how the heart beat of the patient is changing with time. (Medium)
    - A person's resting heart rate is thought to be a factor in determining a person's risk of a heart attack
    - **Irregular Heart rate may be a result of heart disease but may not necessarily be correlated with mortality rate.**
    - Patients having irregular heart rate can be given extra care.
16. Systolic BP: The pressure measured as the heart beats and moves blood into arties. (Medium)
    - Greater risk of stroke and heart disease related to higher systolic pressures
    - **Irregular Systolic BP may increase chances of heart disease but may not necessarily be correlated with mortality rate.**
    - Patients having irregular systolic BP can be given extra care.
17. Distalolic BP: Measure the pressure in your arties when your heart rests between beats. (Medium)
    - If someone has elevated diastolic blood pressure, chances of heart disease and stroke are higher.
    - **Irregular Distalolic BP may increase chances of heart disease but may not necessarily be correlated with mortality rate.**
    - Patients having irregular distalolic BP can be given extra care.
18. Respiratory rate: The change in breathing capacity of a patient along with time. (Medium)
    - If your heart isn't pumping enough oxygen-containing blood around the body, your body responds by breathing faster to try to get more oxygen into your body, making you feel short of breath.
    - **Irregular Respiratory rate may be a result of heart disease but may not necessarily be correlated with mortality rate.**
    - Patients having irregular respiratory rate can be given extra care.

19. Temperature: The current temperature of a patient. (Medium)
    - The changes in the cardiovascular system that develop in chronic heart failure obviously affect thermoregulation.
    - **Temperature may be a result of heart disease but may not necessarily be correlated with mortality rate.**
    - Patients having high temperature can be given extra care.
20. SPO2: The Partial Pressure of oxygen in the patient. (High)
    - Low oxygen levels in the heart have long been known to produce life-threatening arrhythmias, even sudden death
    - **SPO2 may have high correlation with mortality rate.**
    - Patients having low SPO2 can be given extra care and can be shifted to level 2 ICU to reduce mortality rate.
21. Urine Output: The urine output of a patient in cc/kg/hour. (Medium)
    - Heart failure may cause decreased blood flow to the kidneys, which causes you to retain more fluid. One of the signs of this fluid may be frequent urination.
    - **Frequent Urine output may be a result of heart disease but may not necessarily be correlated with mortality rate.**
    - Patients having frequent unine can be given extra care.
22. Hematocrit: Percentage by volume of red blood cells in the blood. (Medium)
    - The increased hematocrit in coronary patients creates significantly higher whole blood viscosity than that observed in healthy controls. This hemodynamic factor may be responsible for the development of clinical symptoms of coronary heart disease and possibly of the basic vascular disease itself.
    - **Higher Hematocrit may increase the chance of heart disease but may not necessarily be correlated with mortality rate.**
    - Patients having higher hematocrit can be given extra care.
23. RBC: Red blood cells, carries fresh oxygen all over the blood. (Medium)
    - Your body may increase red blood cell production to compensate for any condition that results in low oxygen levels, including: Heart disease (such as congenital heart disease in adults) Heart failure.
    - Anemia(Low RBC) can lead to a rapid or irregular heartbeat (arrhythmia). When you're anemic your heart pumps more blood to make up for the lack of oxygen in the blood. This can lead to an enlarged heart or heart failure
    - **Irregular RBC may be a result of heart disease but may not necessarily be correlated with mortality rate.**

- Patients having irregular RBC can be given extra care.

24. MCH: Mean corpuscular hemoglobin, means average quantity of hemoglobin concentration in single RBC. (High)
    - High hemoglobin levels could signal a rare blood disorder called polycythemia. In polycythemia, the body makes too many red blood cells, causing the blood to be thicker than usual. This can lead to clots, heart attacks, and stroke. It is a serious lifelong condition that can be fatal without treatment.
    - **MCH may have high correlation with mortality rate.**
    - Patients having high MCH can be given extra care and can be shifted to level 2 ICU to reduce the mortality rate.
25. MCHC: Mean Corpuscular hemoglobin Concentration, means average concentration of hemoglobin inside RBC. (High)
    - MCHC, a common indicator of anemia, has been shown to correlate with the prognosis of myocardial infarction, congestive heart failure (CHF)
    - **MCHC may have high correlation with mortality rate.**
    - Patients having high MCHC can be given extra care and can be shifted to level 2 ICU to reduce the mortality rate.
26. MCV: Mean corpuscular Volume, measurement of average size of RBC. (Medium)
    - MCV is a marker of erythrocyte size and activity and is associated with prognosis of cardiovascular disease.
    - **MCV may be a result of heart disease but may not necessarily be correlated with mortality rate.**
    - Patients having irregular MCV can be given extra care.
27. RDW: Red Cell distribution Width, Width of your RBC. (High)
    - Increase in RDW value is associated with higher risk of death
    - **RDW may have high correlation with mortality rate.**
    - Patients having high RDW value can be given extra care and can be shifted to level 2 ICU to reduce the mortality rate.
28. Leucocytes: Cells which made in bone morrow and helps body to fight with infection and other diseases (High)
    - Elevated concentrations of leukocytes have been associated with increased incidence of myocardial infarction (MI) and stroke14–19 and worse prognosis in subjects with coronary heart disease.
    - **Leucocytes may have high correlation with mortality rate.**

- Patients having high leucocytes concentraion can be given extra care and can be shifted to level 2 ICU to reduce mortality rate.

29. Plateletes: They are tiny blood cells and help body for clotting purpose and can be seen only from microscope. (Medium)
    - Too many platelets, however, can cause your blood to become too sticky. In severe cases, thrombocytosis can cause dangerous clots in your blood vessels, increasing your risk of a stroke or heart attack.
    - **Irregular platelet count may lead to heart disease but may not necessarily be correlated with mortality rate**
    - Patients having irregular platelet count can be given extra care.
30. Neutrophils: Type of WBC which helps body to fight with infection. (Medium)
    - After heart attack, the first wave of innate responsive and short-lived neutrophils is essential for the initiation of inflammation, resolution of inflammation, and cardiac repair, however uncontrolled and long-term activation of neutrophils leads to collateral damage of myocardium.
    - **Enhanced neutrophils may be a result of heart attack but may not necessarily be correlated to mortality rate.**
    - Patients having high neutrophils can be given extra care.
31. Basophils: Kind of WBC, they have ability to detect and destroy some early cancerous cells. (High)
    - Basophil Blood Cell Count Is Associated With Enhanced Factor II Plasma Coagulant Activity and Increased Risk of Mortality in Patients With Stable Coronary Artery Disease
    - **Low basophils may have high correlation with mortality rate.**
    - Patients having low basophils can be given extra care and can be shifted to level 2 ICU for reducing the mortality rate.
32. Lymphocytes: Type of WBC, helps body's immune system to fight with cancerous cells/viruses and bacteria. (Medium)
    - A high number of white blood cells and their subtypes (for example, neutrophils, monocytes, lymphocytes, and eosinophils) are associated with the presence of coronary heart disease, peripheral arterial disease, and stroke
    - **Enhanced lymphocytes may be a result of heart disease but may not necessarily be correlated to mortality rate.**
    - Patients having high lymphocytes can be given extra care.
33. PT: Prothrombin Time, also referred as pro-time. Test to evaluate time for blood clotting (High)

- Higher PT-INR level, rather than lower PT-INR, is an independent predictor of all-cause mortality in CAD(Coronary artery disease) patients.
- **PT may have high correlation with mortality rate.**
- Patients having high PT can be given extra care and can be shifted to level 2 ICU for reducing the mortality rate.

34. INR: International normalized ratio, Type of calculation based on PT test results. (High)
    - Higher PT-INR level, rather than lower PT-INR, is an independent predictor of all-cause mortality in CAD(Coronary artery disease) patients.
    - **INR may have high correlation with mortality rate.**
    - Patients having high INR can be given extra care and can be shifted to level 2 ICU for reducing the mortality rate.
35. NT-proBNP: N-Terminal (NT)-proB-type Natriuretic Peptide, kind of blood test. BNP hormone produced by the heart and changes and abnormalities related to heart failure. (High)
    - If you have heart failure, the following NT-proBNP levels could mean your heart function is unstable: Higher than 450 pg/mL for patients under age 50. Higher than 900 pg/mL for patients age 50 and older.
    - **Enhanced NT-proBNP may have high correlation with mortality rate.**
    - Patients having high NT-proBNP can be given extra care and can be shifted to level 2 ICU for reducing the mortality rate.
36. Creatine Kinase (CK): Tests are there to measure CK enzyme. CK enzyme mostly found in your skeletal muscle and heart. (Medium)
    - The test can be used to help diagnose a heart attack
    - **Elevated Creatine Kinase may be a result of heart attack but may not necessarily be correlated to mortality rate**
    - Patients having high creatine kinase can be given extra care.
37. Creatinine: It is chemical compound left over from energy-producing processes in muscles. (High)
    - Elevated serum creatinine has been associated with increased mortality in hypertensive persons, the elderly, and patients with myocardial infarction or stroke in whom cardiovascular disease is the major cause of death.
    - **Enhanced creatinine may have high correlation with mortality rate.**
    - Patients having high creatinine can be given extra care and can be shifted to level 2 ICU for reducing the mortality rate.
38. Urea Nitrogen: Test tells about functionality of kidneys. (High)

- High blood urea nitrogen (BUN) levels were associated with poor cardiovascular (CV) outcomes in patients with compensated heart failure (HF) and reduced left ventricular ejection fraction (LVEF)
- **Elevated blood urea nitrogen may have high correlation with mortality rate.**
- Patients having high urea Nitrogen can be given extra care and can be shifted to level 2 ICU for reducing the mortality rate.

39. Glucose: Measures glucose level in the blood. (Medium)
    - High blood glucose from diabetes can damage your blood vessels and the nerves that control your heart and blood vessels. Over time, this damage can lead to heart disease.
    - People with diabetes tend to develop heart disease at a younger age than people without diabetes.
    - **Blood glucose may cause heart disease but may not necessarily be correlated to mortality rate**
    - Patients having high blood glucose can be given extra care.
40. Blood Potassium: Potassium test measures the amount of potassium in blood serum, the fluid in blood. (Medium)
    - Patients with heart failure, elevated aldosterone promotes sodium reabsorption, thus less sodium is delivered to the distal nephron resulting in impaired excretion of potassium
    - **Elevated blood potassium may be a result of heart disease but may not necessarily be correlated to mortality rate.**
    - Patients having high blood potassium can be given extra care.
41. Blood Sodium: The test used to find and monitor conditions that effects the balance of fluids in the body. (High)
    - Low serum sodium level is the most common electrolyte disorder and is frequently encountered in patients with advanced heart failure.
    - **Low blood sodium may have high correlation with mortality rate.**
    - Patients having low blood sodium level can be given extra care and can be shifted to level 2 ICU for reducing the mortality rate.
42. Blood calcium: Measures calcium in your body. Unbalanced calcium level include thyroid problems, bone disease etc. (Medium)
    - Calcium deposits are part of artery-clogging plaque. They also contribute to stiffening of the arteries and interfere with the action of heart valves.
    - **Abnormal blood calcium levels may lead to heart disease but may not necessarily be correlated to mortality rate.**

- Patients having abnormal blood calcium can be given extra care.

43. Chloride: Measures chloride in the body. It will tells about electrolyte, fluids, acids and bases. (High)
    - Lower serum chloride levels are independently and incrementally associated with increased mortality risk in patients with chronic heart failure.
    - **Lower serum chloride levels may have high correlation with mortality rate.**
    - Patients having low chloride level can be given extra care and can be shifted to level 2 ICU for reducing the mortality rate.
44. Anion gap: It measures the gap between the positively and negatively charged electrolyte in blood. Test tells about the acid- base behaviour. (Medium)
    - Serum anion gap (SAG) is associated with the severity of various cardiovascular diseases.
    - **Increased anion gap may be an indication of heart disease but may not necessarily be correlated to mortality rate.**
    - Patients having high anion gap can be given extra care.
45. Mg2+ Ion: Used to check magnesium ions in your blood. Present in unbalanced way it will cause problem. (Medium)
    - Depletion of Mg2+ by alcohol in cardiac cells causes an increase in intracellular Ca2+, leading to coronary artery vasospasm, arrhythmias, ischemic damage and cardiac failure.
    - **Lower Mg2+ may lead to heart disease but may not necessarily be correlated to mortality rate.**
    - Patients having low Mg2+ can be given extra care.
46. pH: It measures how often your stomach acid enters the esophagus(connection between throat and stomach) (Medium)
    - Low pH(Acidic) may lead to heart disease but may not necessarily be correlated to mortality rate.
    - Patients having low pH level can be given extra care.
47. Bicarbonate: Measures amount of bicarbonate, a form of CO2 in blood. Gives idea regarding acid-base balance. (Medium)
    - Higher bicarbonate was associated with a higher risk of incident heart failure.
    - **Higher bicarbonate may be a result of heart disease but may not necessarily be correlated to mortality rate.**
    - Patients having high bicarbonate can be given extra care.

48. Lactic acid: It measures lactic acid in the body. It often used to measure lactic acidosis. (Medium)
    - Type A lactic acidosis is caused by a lowered amount of blood flow in the tissue, called hypoperfusion. Hypoperfusion can be caused by heart failure, or cardiac arrest (when the heart stops beating).
    - **Increased lactic acid may be a result of heart disease but may not necessarily be correlated to mortality rate.**
    - Patients having high lactic acid level can be given extra care.
49. PCO2: Partial Pressure of CO2 within arterial and venous blood. (Medium)
    - **Higher PCO2 is a result of heart disease but may not necessarily be correlated to mortality rate.**
    - Patients having high PCO2 level can be given extra care.
50. EF: Ejection Fraction, percentage of blood leaving your heart each time it contracts. (Medium)
    - An ejection fraction below 40 percent means your heart isn't pumping enough blood and may be failing. A low ejection fraction number can be an indicator of heart failure
    - **Low ejection fraction may be a result of heart disease but may not necessarily be correlated to mortality rate.**
    - Patients having low Ejection Fraction can be given extra care.

Suggest ways in which the organisation can benefit as a result of analysing the data

Reducing the overall mortality in the general population.

- The analysis of data(includes 50 different independent variables) help medical organizations to spread awareness as well as prevent general causes(independent variables) which led to higher mortality rates.
- Expansion of medical organizations to increase the last mile medical facilites to the general population.

Optimazation of cost of medical treatements

- With proper analysis of independent variables cost of medical treatement for the general population can be optimized.

Establishing a new community-oriented business

- After analyzing the independent variables hospitals can set up their own fitness center to make sure their patients(with high depression, hipertensive, high blood gloucose etc.) remained healthy even after hospital visits. Running a community fitness center is not a traditional path for a hospital, but one that's aligned to any hospital's mission while providing a new revenue stream.

Hospitals can get into telemedicine/telehealth

- Telemedicine, which enables video or phone appointments between a patient and their health care practitioner, benefits both health and convenience.
- This could generate new revenue stream for hospitals as it allows even long-distance patient to get consultation.

Suggest missing features that can help with the analysis based on business logic

- Location
  - Weather its near induatrial area or highway etc.
  - We can know about the Air Quality Index of that area.
  - We can know about the sound pollution in that area.
  - How far is it from the hospital and how much time it will take for an ambulance to reach in case of an emergency.
- Lifestyle choices
  - Do they have a regular drinking/smoking habit?
  - Do they have a sedentary lifestyle with little to no exercise?
  - Do they predominantly prefer fast food over healthy balaced diet?
  - Are they getting enough sleep?
- Family medical history
  - A family health history can identify people with a higher-than-usual chance of having common disorders, such as heart disease, high blood pressure, stroke, certain cancers, and type 2 diabetes.
- Avalilability of primary healthcare facilities
  - Provision of essential drugs
  - Promotion of food supply and proper nutrition
  - Immunization against major infectious diseases

- Adequate supply of clean water and basic sanitation

What is the best way to collect data for the suggested features ?

Location

- Can collect info about location at the time of consultation or patient admission.

Lifestyle choices

- Can collect data from digital devies like smart watches and smart bands(if any) to know more about patients.
- Wearable devices can track about sleep patterns and daily step counts
- Health apps can track daily calorie intake and other such metrics.

Family medical history

- Can collect info about family medical history at the time of consultation or patient admission.

Availability of primary healthcare facilities

- Can setup medical camps in different oranizations like school/govenment offices to collect data and provide awarness