EARLY IDENTIFICATION AND DETECTION OF SEPSIS USING AI/ML -BASED ALGORITHM: A LITERATURE REVIEW

UNDER THE MENTORSHIP OF –

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BY – SARANSH KHANNA

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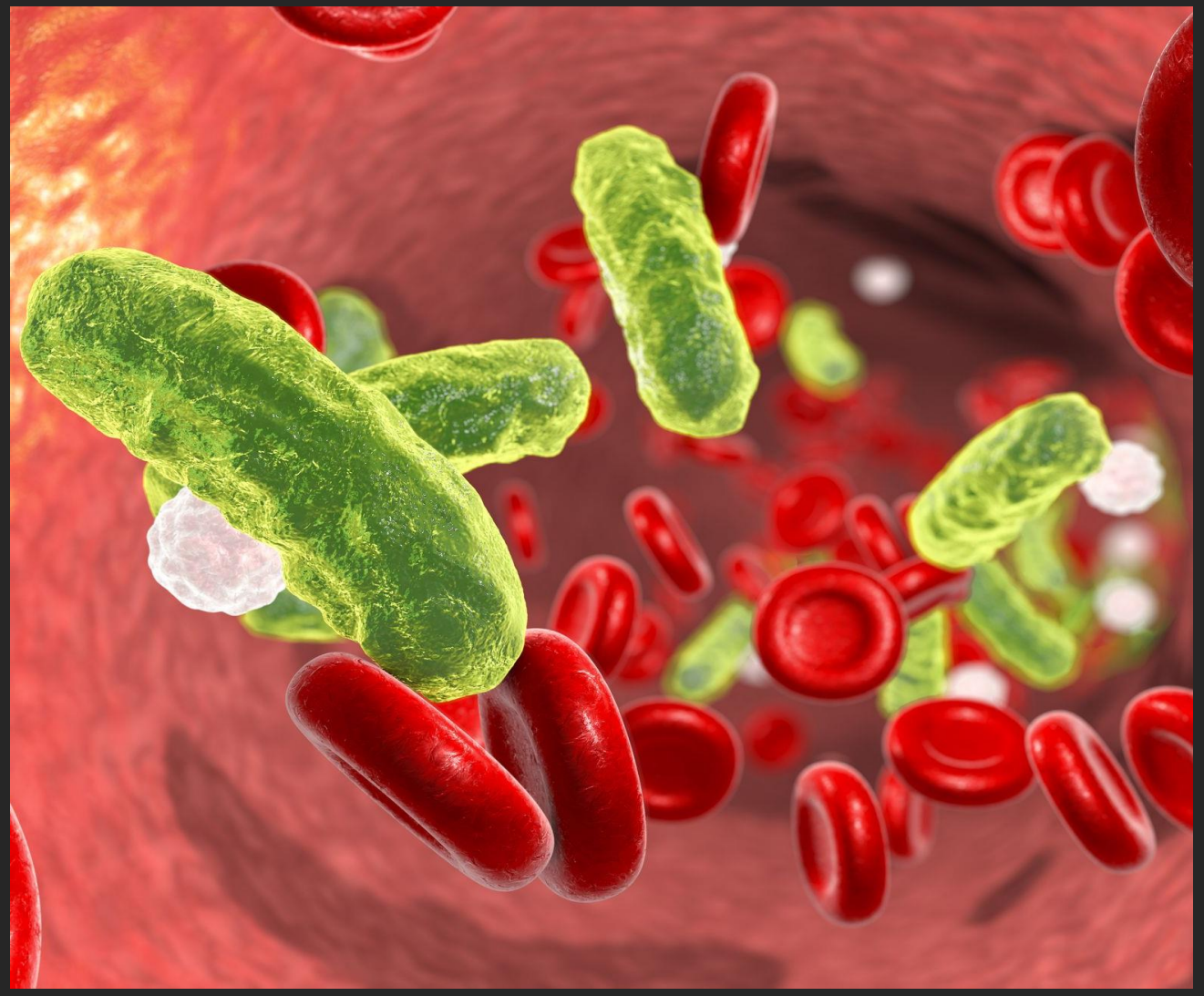

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WADHWANI AI

MENTOR APPROVAL

Saransh khanna
Good evening Sir, I hope you are doing well. Please find the attached dissertation presentation for approval. So, that I can present it on Saturday....
Tue 6/13/2023 5:49 PM

Dr. Sukesh Bhardwaj
To: Saransh khanna
Cc: Anju; Mr.Tarun Kumar Nagpal
Thu 6/15/2023 8:33 PM

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9 MB

Dear Saransh,

Approve the same. Kindly make the font readable it is so small to read and understand.

Regards,
Dr. Sukesh

...

Saransh khanna
Good evening sir, Thank you so much. I'll do the needful changes as you have mentioned. Best regards, Saransh Khanna Get Outlook for Android
Thu 6/15/2023 8:51 PM

Dr. Sukesh Bhardwaj
Sounds good, thank you.
Thu 6/15/2023 8:57 PM

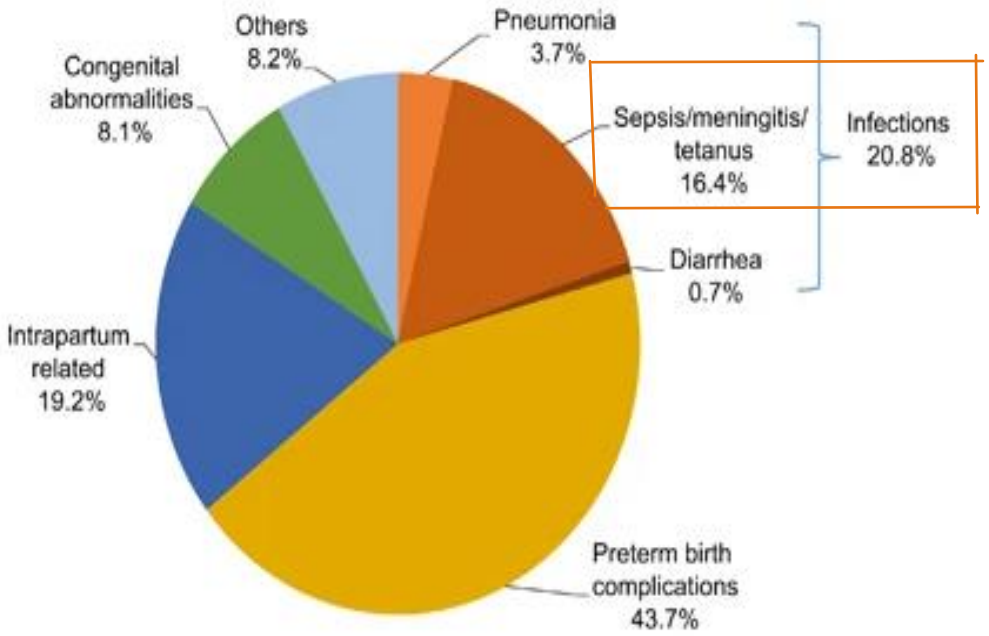
INTRODUCTION:

Sepsis?

- Sepsis is a global health problem that is defined as a 'life-threatening organ dysfunction caused by a dysregulated host response to infection'.

Disease burden of Sepsis:

- Worldwide 1 in 5 deaths are related to sepsis. (1)
- In 2017, it was estimated that 11 million sepsis cases were identified in India, and close to 3 million deaths occurred. (2)
- In India, 34% of sepsis patients die in the Intensive care unit (ICU). (3)
- Journal of Perinatology study found that sepsis/meningitis/tetanus together contribute to 16.4% of neonatal deaths in India. (2)



Causes of neonatal deaths in India.

1. https://www.thelancet.com/journals/langlo/article/PIIS2214-109X(22)00043-2/fulltext
2. https://www.nature.com/articles/jp2016183
3. https://www.healthdata.org/research-article/global-regional-and-national-sepsis-incidence-and-mortality-1990%E2%80%932017-analysis

INTRODUCTION:

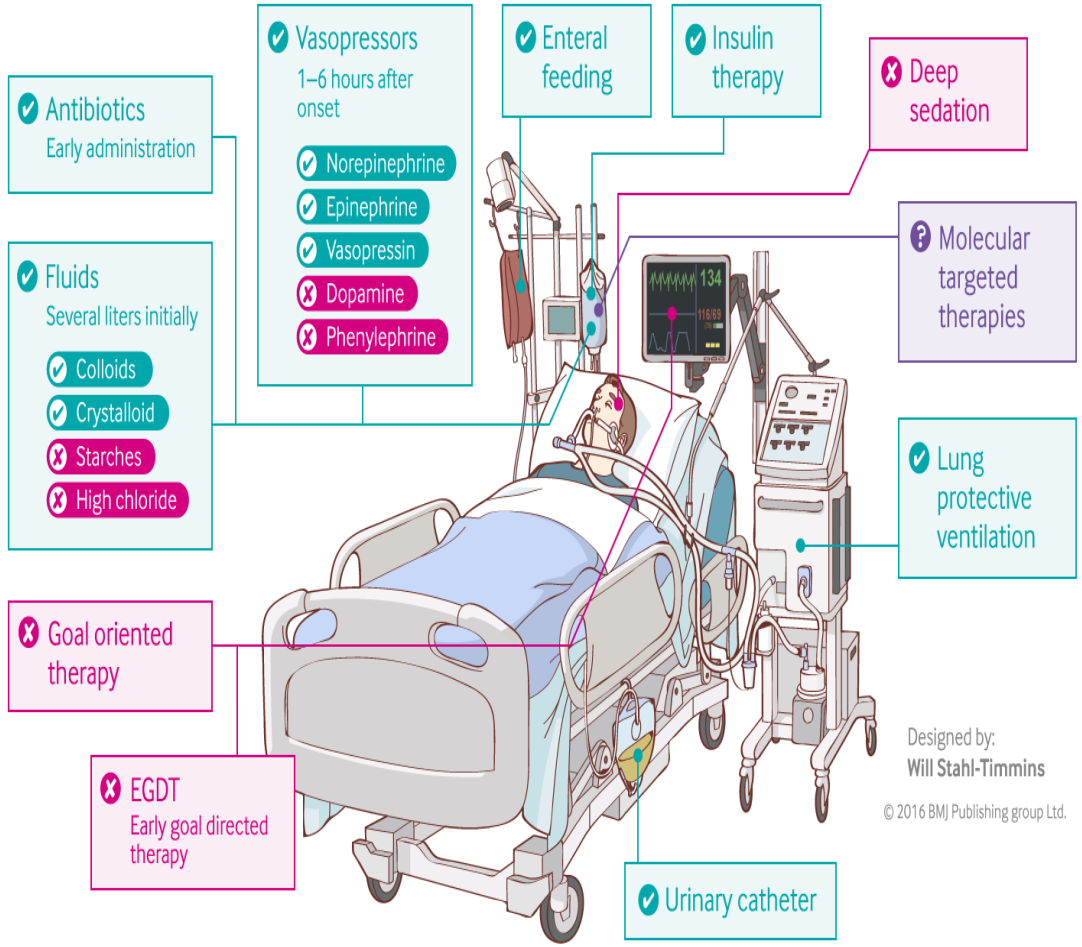
Who are at high risk?

- Anyone who has an infection can develop sepsis, but some are at high risk such as -

1. Neonates,
2. Pregnant women,
3. The elderly,
4. Hospitalized patients,
5. Immunosuppressed people, and
6. Patients with chronic diseases.

Can we treat Sepsis?

- Yes, treatment can be done but the window period for clinically diagnosing sepsis is very short (3 hours).



Treating sepsis: the latest evidence

OBJECTIVE:

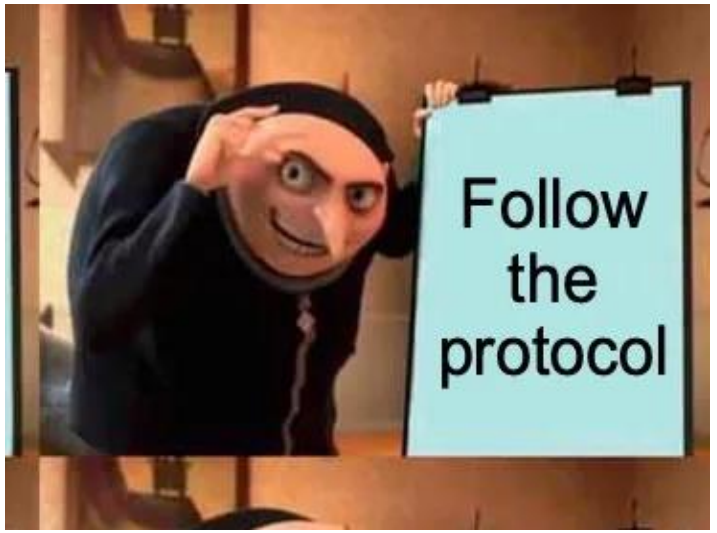
PRIMARY:

- The aim of this study is to map the current landscape and the stage of the utility of AI/ML models or algorithms for the early identification and prediction of sepsis.

SECONDARY:

- Understanding the various variables used for the identification of sepsis according to studies available.
- Understanding the various AI/ML models or algorithms used for the identification of sepsis according to studies available.

METHODOLOGY:



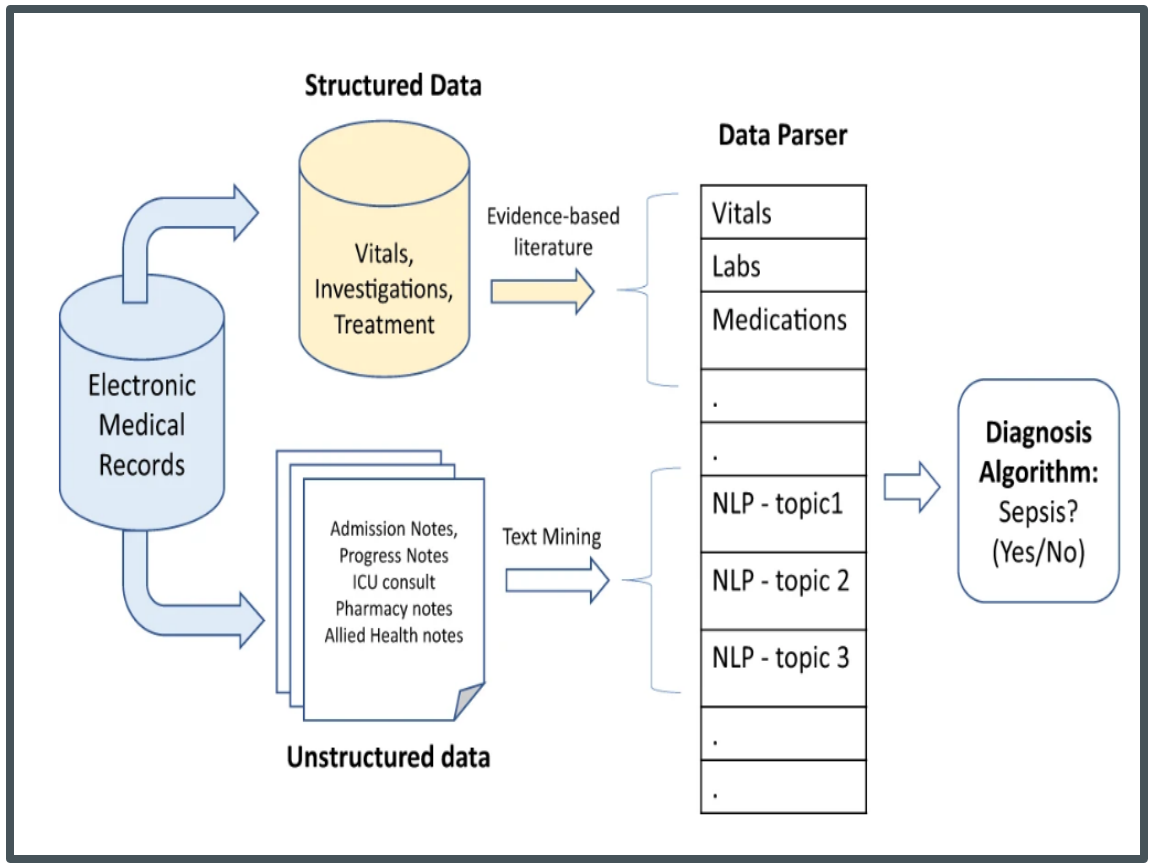
- **Study design:** Secondary research
- **Eligibility criteria:** A literature collection using databases/ search engines such as PubMed, Web of Science, and Google Scholar was done and compiled to answer our research questions.
- **Time:** all the studies published between January 2010 and December 2022 were taken into consideration.

- **Types of studies**: We included -

1. Primary studies, Cohort studies, Cross-sectional studies, Review Papers, and Randomized Controlled trials (RCTs).
2. Full text or abstract only.
3. Studies with English language were included and studies having a foreign language other than English were not be considered.

- **Types of participants:** People having a high risk of sepsis such as hospitalized patients, neonates, pregnant women, the elderly, immunosuppressed people, and patients with chronic diseases were included.
- **Types of Intervention:** Use of AI/ML-based tools for early prediction of sepsis in any tertiary care hospital, medical college, or healthcare center.

RESULTS:



➢ Study - 1

- **AI Solution: Global Impacts**
  - A prospective, multi-site cohort study, was done for 3 years.
  - To examine a sepsis alert system called Targeted Real-time Early Warning System (TREWS) across 5 hospitals in the Maryland and DC areas.
  - **Results** show that those whose alert was confirmed within 3 hours of the alert had a reduced in-hospital mortality rate, organ failure, and length of stay compared with patients whose alert was not confirmed within 3 hours. (1)

1. https://www.nature.com/articles/s41591-022-01894-0

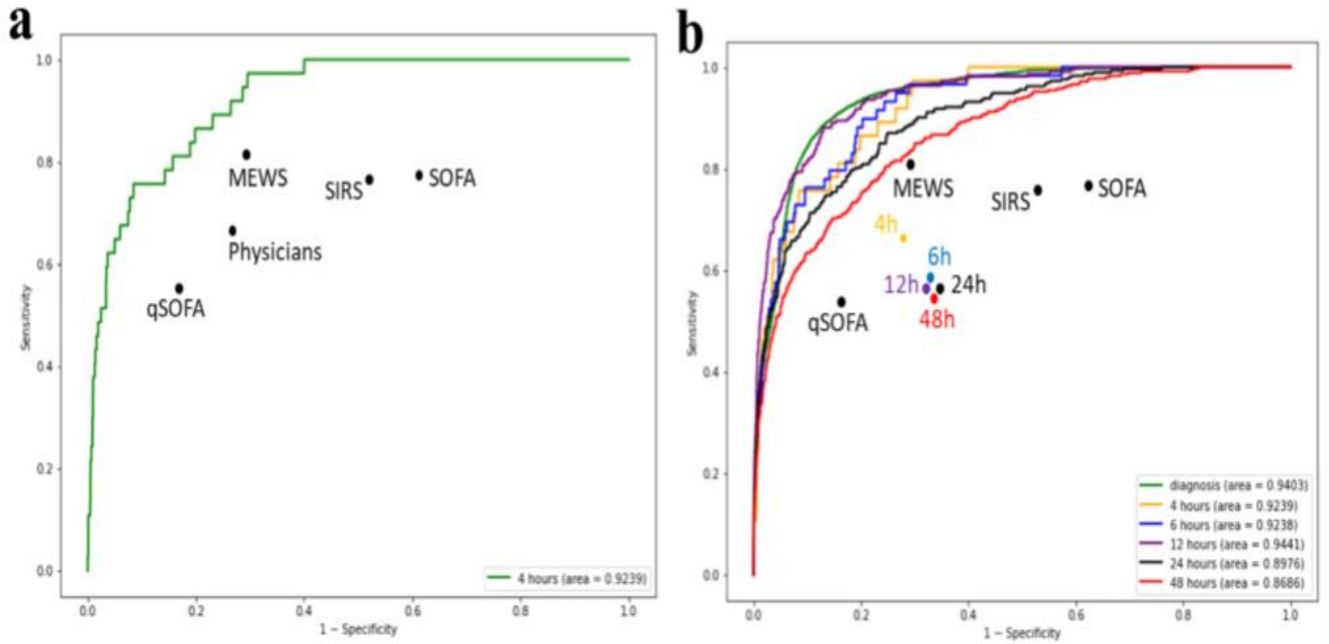
RESULTS:

AI Prediction Vs Human Prediction -

➢ Study - 2

- The prediction algorithm VS Commonly used standardized scoring system by clinicians were analyzed.
- **Results** shows that SERA (early prediction algorithm) outperformed huma n based scoring system such as q SOFA, MEWS, SIRS, SOFA. (1)

From: Artificial intelligence in sepsis early prediction and diagnosis using unstructured data in healthcare



a, **b** The ROCs represent the performance of early prediction algorithm at 4, 6, 12, 24, and 48 h prior to the onset of sepsis using the independent, test sample. "qSOFA", "MEWS", "SIRS", and "SOFA" represent the TPR and FPR from these methods employed by physicians in prior studies at 0–4 h prior to the onset of sepsis. "Physicians" represent TPR and FPR of patients in the independent, test sample set that were suspected by hospital's physicians to have sepsis at 4 h prior to the onset of sepsis. **b** "4 h", "6 h", "12 h", "24 h", and "48 h" represent TPR and FPR of patients in the independent, test sample set that were suspected by hospital's physicians to have sepsis at the respective time prior to the onset of sepsis.

- As a result, an AI/ML-based tool may be able to track this problem by early recognition of deteriorating physiological parameters reducing the mortality from sepsis.

1. https://www.nature.com/articles/s41467-021-20910-4

RESULTS:

- **List of variables for identification of sepsis according to studies.**

Physiological Features

- Heart Rate
- Respiration Rate
- Temperature
- Blood Pressure
- Mean Blood Pressure
- Skin Colour
- Nail Bed
- Mental State
- Blood Glucose/Diabetes
- Positive fluid balance
- Spo2/Hypoxemia
- Urine Output
- Apnea
- Catheter Insertion
- PaCo2, Pao2, & Fio2
- Pao2/Fio2 Ratio
- Central Venous Line
- Arterial Line
- Mechanical Ventilation
- Intubated-free days
- Inotrope-free days
- Antibiotics use
- ECMO use
- Length of stay (Hours)

Scores

- APACHE II
- SOFA/qSOFA
- APS III (Acute Physiology Score)
- GCS (Glasgow Coma Score)
- SIRS (Systemic Inflammatory Response Syndrome)
- Shock Index
- INR (International Normalization Ratio

Lab Findings

- Mean CCI(Charlson Comorbidity Index)
- RDW (Red blood Cell Volume Width)
- BUN (Blood Urea Nitrogen)
- Arterial Lactate/Serum Lactate
- Creatinine
- PLT (Platelet)
- WBC (White Blood Cell)
- C-reactive Protein
- Bilirubin Levels
- Blood Culture
- Albumin
- Arterial PH
- Calcium/Ionised Calcium
- Hemoglobin
- Magnesium
- PTT (Partial Thromboplastin Time)
- Potassium
- SGPT (Serum Glutamic-Pyruvic Transaminase)
- SGOT (Serum Glutamic-Oxaloacetic Transaminase)
- Chloride
- Bicarbonate
- Sodium
- Co2 Levels
- PT (Prothrombin Time)
- Urea
- ABG (Arterial Blood Gas)
- Leukocytes
- Neutrophils %
- Basophils %
- Band Cell Number and %
- D-dimner
- Eosinophils
- Lymphocytes
- Cholinesterase
- LDL (Low density Lipoprotein)
- LDH (Lactate Dehydrogenase)
- TBIL (Total Cholesterol)

History

- Dementia
- Neurological Sequelae
- Malignancy/Malignant Cancer
- Metastatic Solid Tumor Cancer
- Renal Disorder
- Chronic Obstructive Pulmonary Disorder
- Congestive Heart Failure/Disease
- Acute Liver Disease
- Gastrointestinal Disorder/Bleeding
- Bronchopulmonary Dysplasia
- Cholestasis
- Comorbidity Necrotizing Enterocolitis
- Comorbidity with IVH or Shunt
- Comorbidity with Lung Disease
- Elixhauser

Demographic Details

- UHID/PID
- Age (Days/Months/Year)
- Gender
- Weight (Kg)
- Race
- Timestamp

CONCLUSION:

- The Sepsis is a phenomena in which an infection alters the balance of the host response.
- Early detection of sepsis are crucial & essential in better treatment and reducing mortality.
- There is no reliable diagnostic test or direct treatment of sepsis.
- Sepsis is a complex disease and its management require highly trained professional.
- AI/ML has been significantly reliable in its application in medicine will continue grow and emerge in future.

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Questions?

Let's talk about it.