Data Science for Healthcare and Life Sciences

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The Healthcare Industry in India

USD 372 Billion

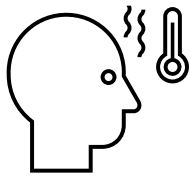Expected to reach in 2022

22% CAGR

Approximate Compound Annual Growth Rate since 2016
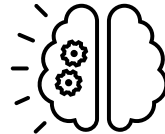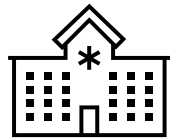
USD 10.6 Billion

Estimated e-health market size by 2025

➢ The industry is undergoing a significant transformation because of rising income levels, ageing population, growing health awareness and changing attitude towards preventive healthcare

➢ Data and AI in healthcare has the potential to add $25-$30 billion to India's GDP by 2025 as per a recent NASSCOM Data and AI report.

Source : https://www.niti.gov.in/sites/default/files/2021-03/InvestmentOpportunities_HealthcareSector_0.pdf
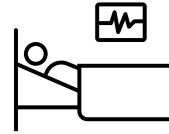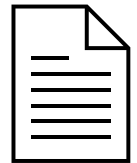
Patient Data Lifecycle

- Registration
- Chat
- Schedule an appointment
- Prepare for visit

- Diagnostics
- Test reports
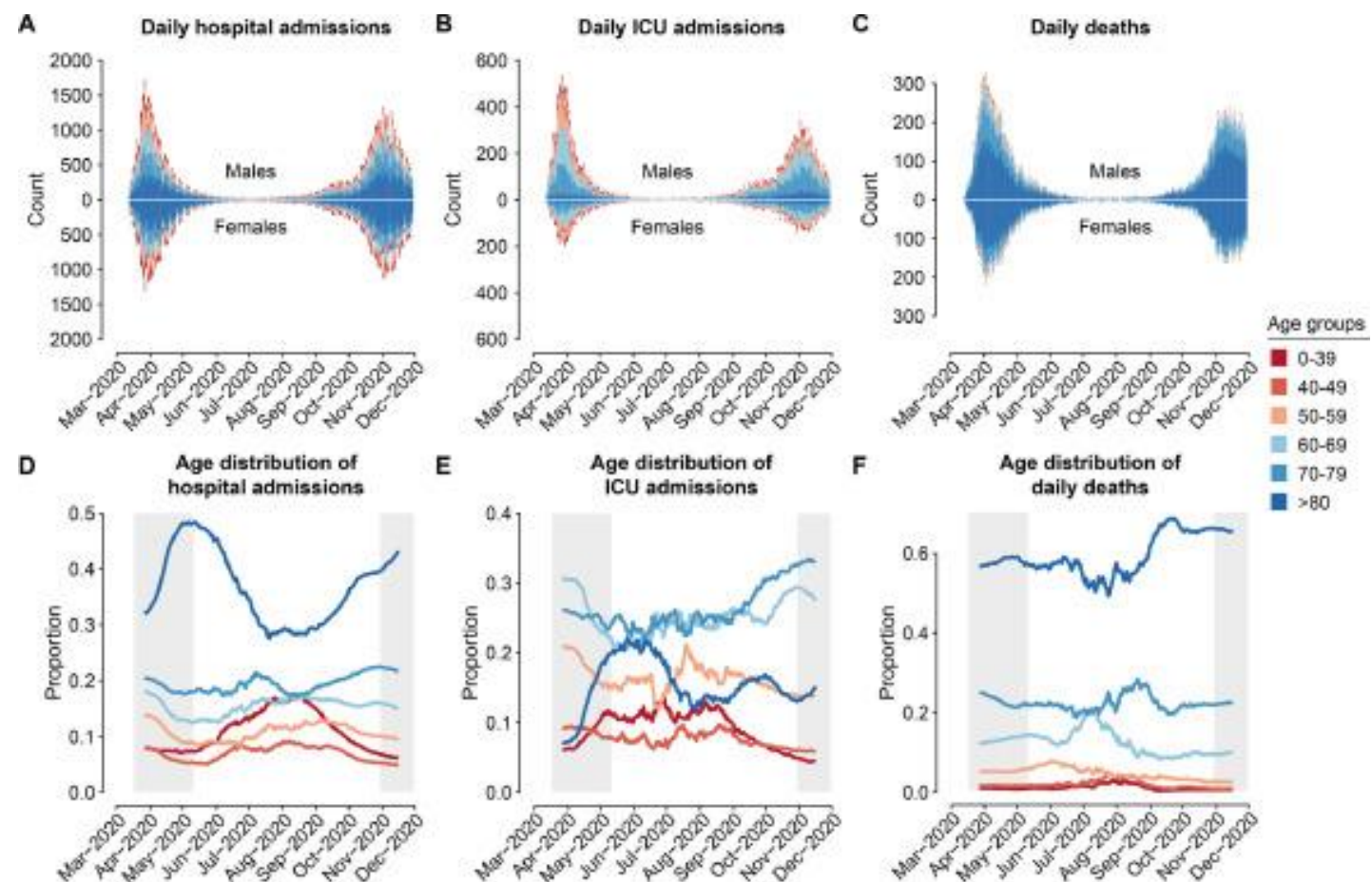- Treatment plan
- Admission records

- Medication and alerts
- Patient profile-based monitoring data
- Inpatient and outpatient attributes
- Discharge summary

- Billing
- Post discharge care
- Health information exchange

Visual Analytics for Data exploration

Data visualization helped in visualizing relations in the data without drawing any inference

A. Daily number of hospital admissions, as a function of time. B. Daily number of ICU admissions, as a function of time. C. Daily number of deaths, as a function of time. In each panel, males counts are shown at the top, females counts are shown at the bottom. D. Age distribution of hospital admissions, as a function of time. E. Age distribution of ICU admissions, as a function of time. F. Age distribution of deaths, as a function of time. Distributions are computed on rolling 28-day windows. Colours represent the age group. Shaded areas on the bottom represent the lockdown periods in France (17 March - 11 May and 30 October - 15 December).

Visual Analytics in the Clinical context

- Visual analytics also address the problem of understanding large amounts of high-dimensional unstructured data

- Helps in understanding *causal* relationships in data which can be an addendum to clinical knowledge
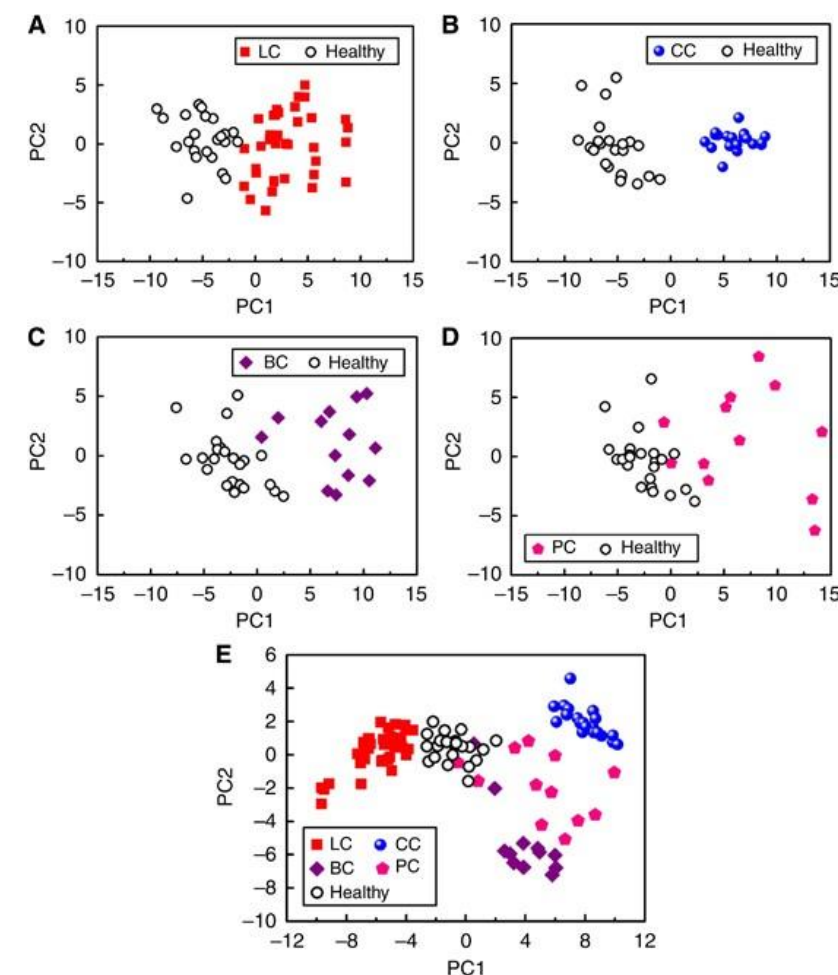
PCA plots of the GNP sensor array's resistance responses of (**A**) lung cancer (LC) and healthy controls, (**B**) colon cancer (CC) and healthy controls, (**C**) breast cancer (BC) and healthy controls, (**D**) prostate cancer and healthy controls, and (**E**) all cancer patients and healthy controls together. Each patient is represented by 1–3 points in plot. The first two principal components depicted contained >88% of the total variance in the data.

Source: https://www.nature.com/articles/6605810

Internet of Medical Things - IoMT

- Connected infrastructure of medical devices, software applications, and health systems and services
- Primarily driven by
  - Wearables
 - Remote Patient monitoring devices

Smart Ambulances
Sensors in ambulances track patient's vitals and share them in real time to the hospital/physician. Better care!

Vitals Monitoring
Dashboards connected to sensors at the ICU beds help in alerting sudden spikes in patient's vitals and trigger alarms in emergency

Implanted Devices
Variety of biosensors that process different signals, that are placed using surgical or medical intervention, or are clinically inserted into a natural orifice


Source: Deloitte Medtech and the Internet of Medical Things Re
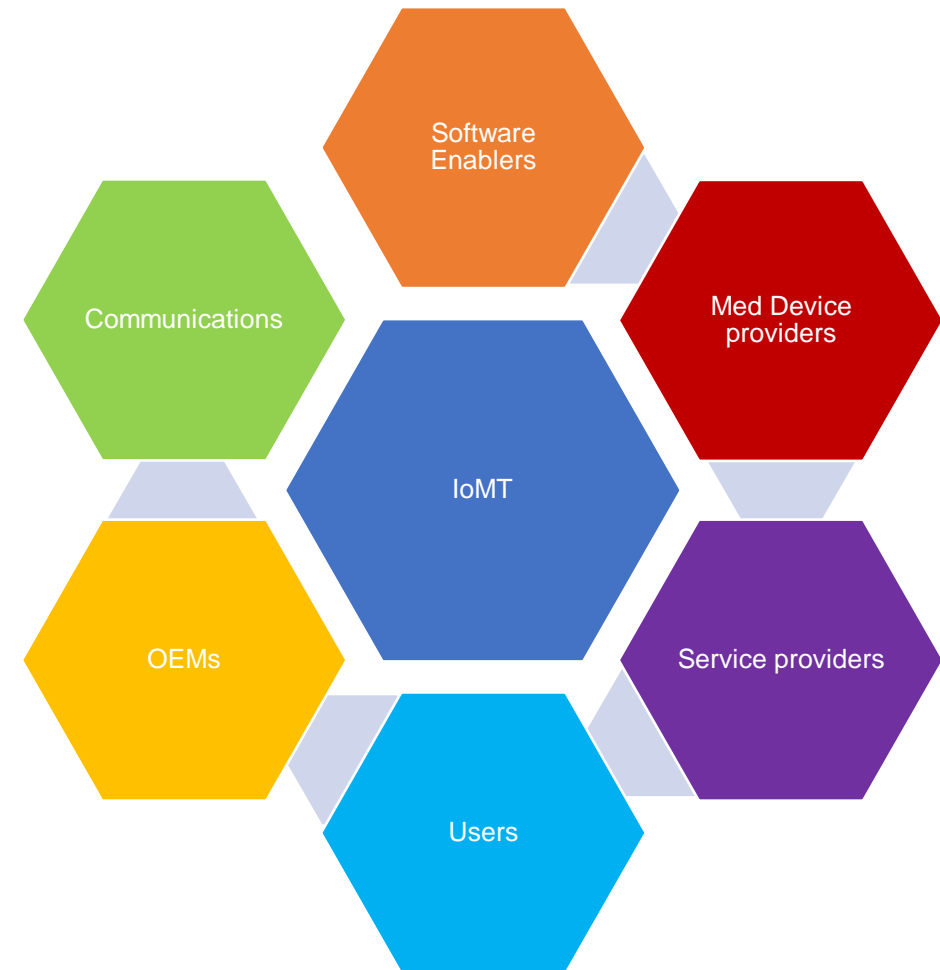
NLP as a game changer

- Transcribed Medical Transcription
- EMR Automation
- Virtual Physical assistant

Tag name	Keyword(s)
FEVER	fever, febrile
CONJUNCTIVAL_INJECTION	conjunctival injection, conj injection, red eyes, redness of eyes
ORAL_CHANGES	red lips, strawberry tongue
EXTREMITY_CHANGES	erythema of palms, erythema of soles, edema of hands, edema of feet, peeling of fingers, peeling of toes
POLYMORPHOUS_EXANTHEMA	rash
CERVICAL_LYMPHADENOPATHY	neck adenopathy, cervical adenopathy
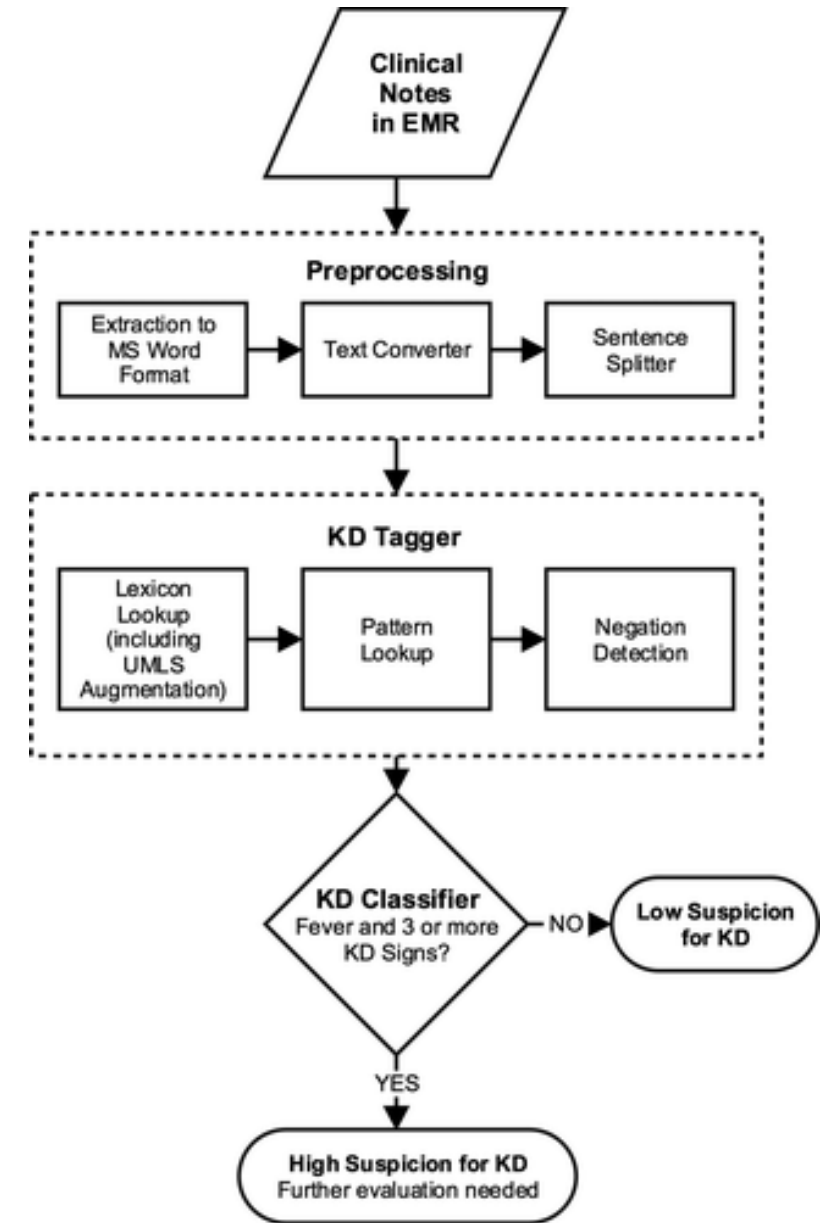
Computational Pathology

- ML approaches developed assist pathologic diagnosis using the basic morphology pattern such as cancer cells, cell nuclei, blood vessels, etc.

- **Whole slide image** Digital representation of an entire histopathological glass slide,

- Correlating images to patient outcome

- GPU-Accelerated Deep Learning techniques help doctors in
  - Automated Analysis
  - Increased accuracy of Diagnostics
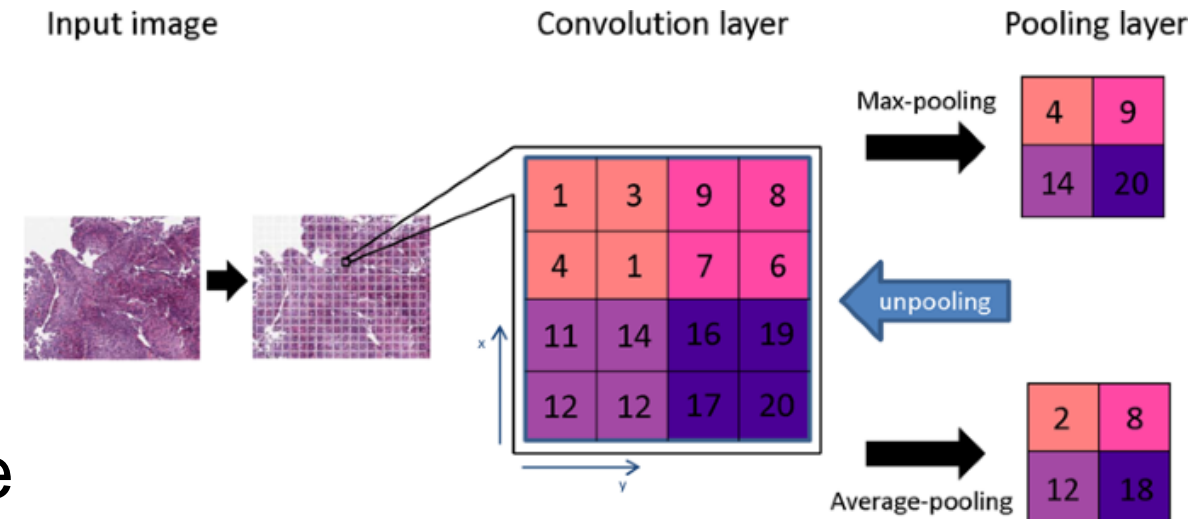
The convolutional neural network generates a pooling layer to reduce the dimensions of the image data as well as retain its characteristics for the statistic modeling

Source :https://www.nature.com/articles/s41374-020-00514-0

Other Use cases

Genomics

- Genome annotation and variant classification

Drug Discovery

- Speed up of clinical trials research
- *discover patterns* in the data pools

Robotic Surgery

- Collaborative Robots
- Improved Precision

The Challenges in Adoption

- Cost / Unaffordability
- Access to relevant data (Collection techniques, systems)
- Low collaboration between all stakeholders involved
- Interoperability
- Privacy and Security