Analytics Landscape in Healthcare

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Agenda

- Analytics
- Types of analytics
- Changing trends in Healthcare
- Top Analytics use cases in Healthcare

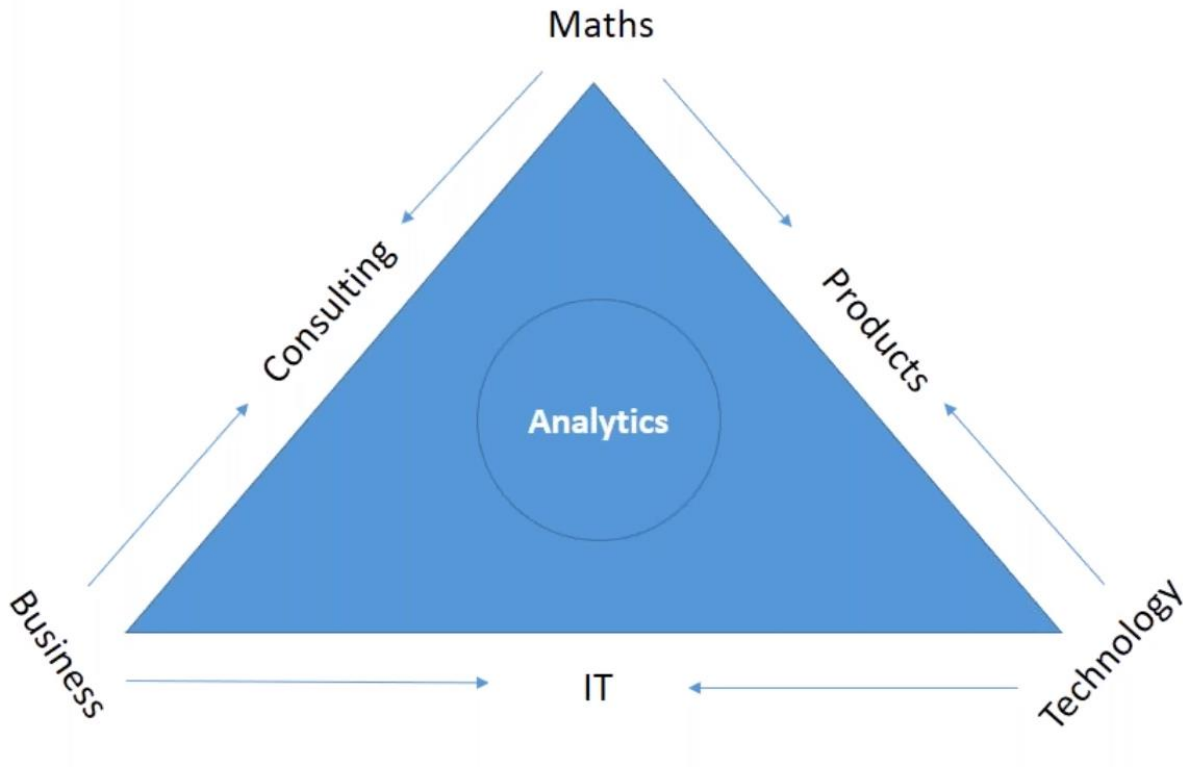
Case studies:

  - Predictive analytics
  - Classification

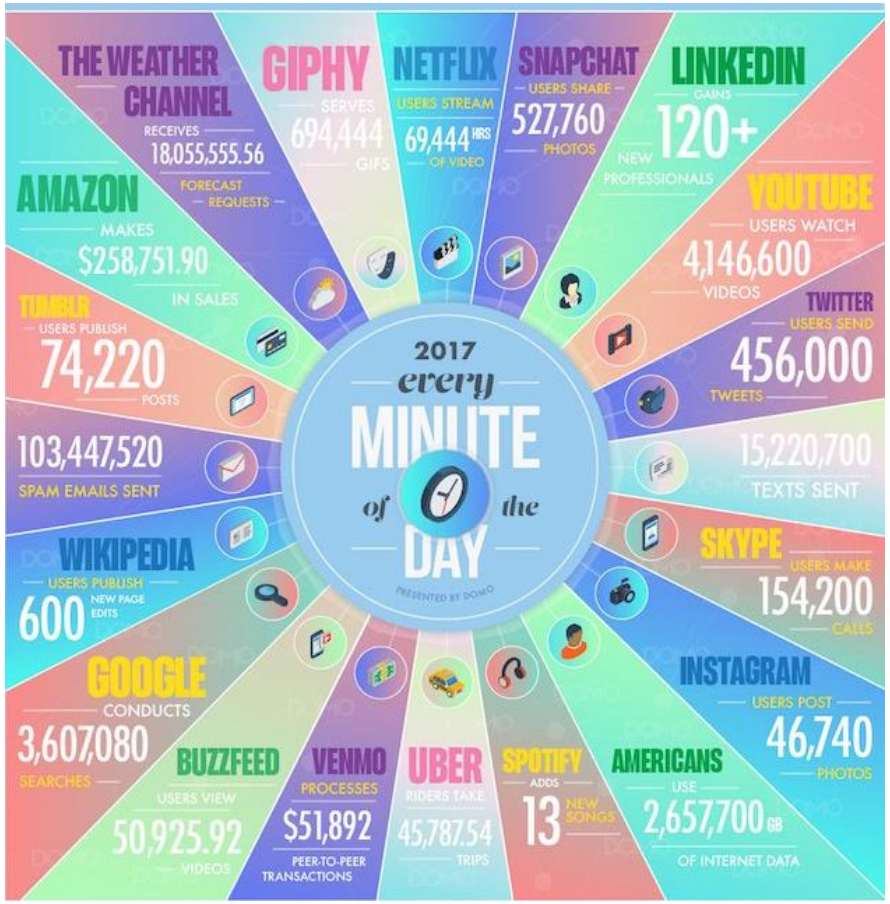
- Challenges to enable analytics in healthcare
- Future Scope
- Summary and references
- Q & A

What is Analytics?

Broad use of data and quantitative analysis for decision making within organizations

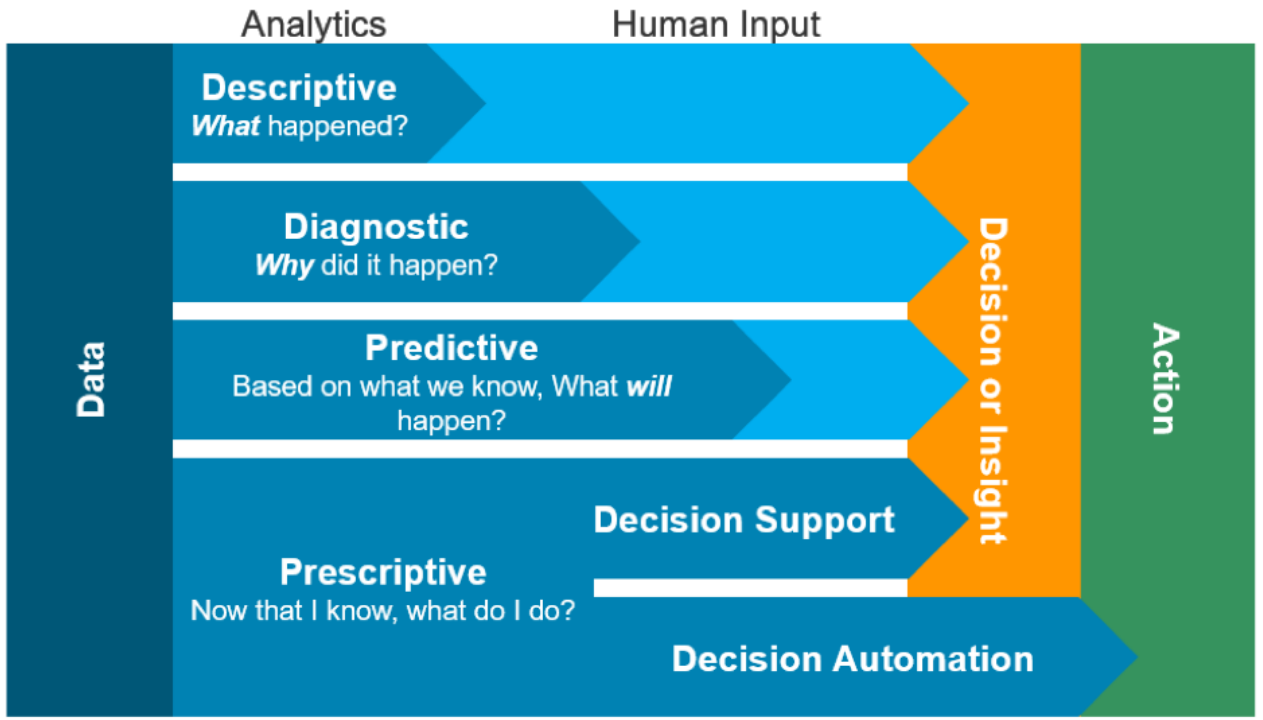


Data we are generating ..



Ref:- https://www.marketingprofs.com/charts/2017/32531/the-incredible-amount-of-data-generated-online-every-minute-infographic

Type of Analytics



Adapted from Gartner Report July 2015

https://www.healthcatalyst.com/closed-loop-analytics-method-healthcare-data-insights

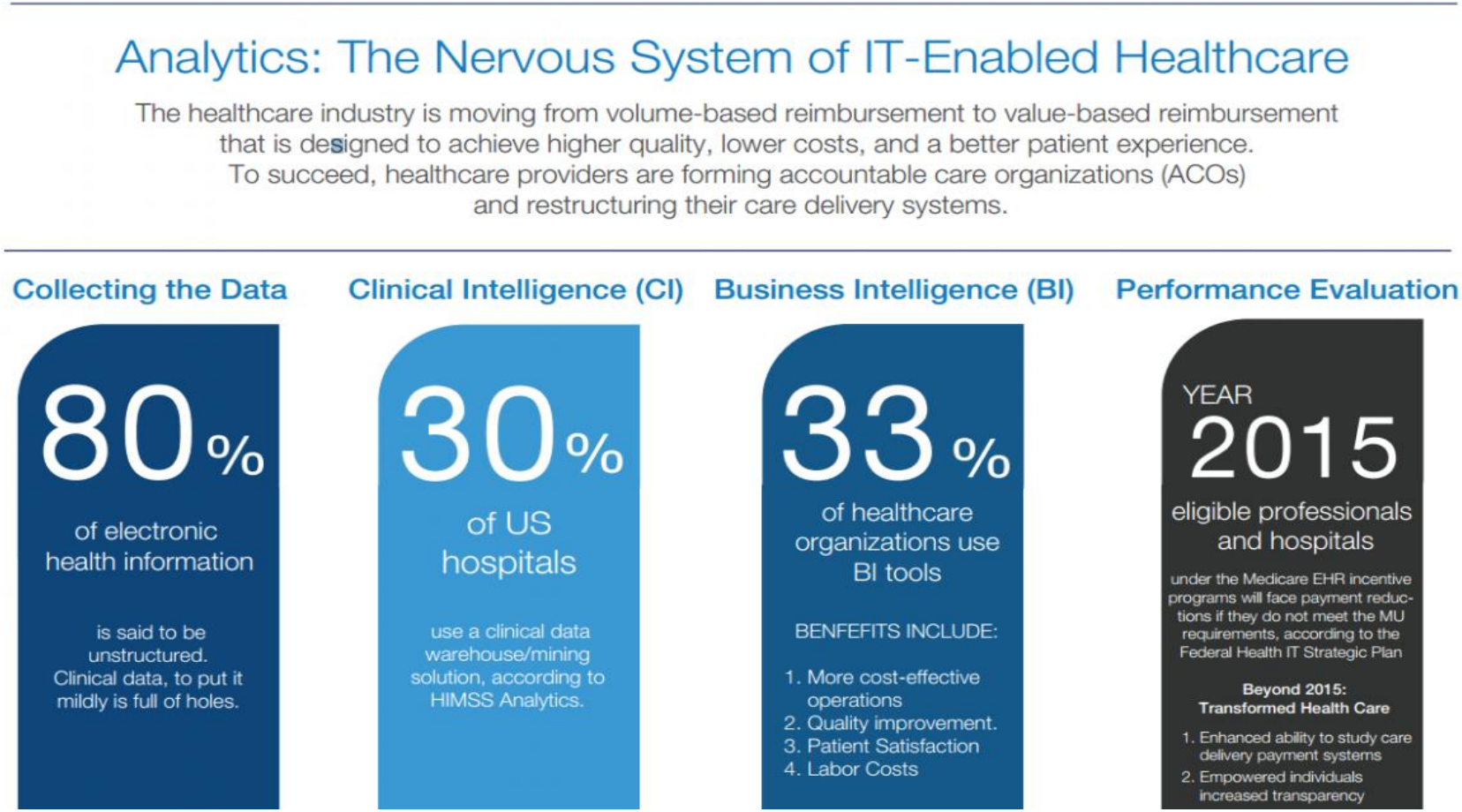
Trends in healthcare

- Resource and access **constraints**
- Aging population
- **Shortage** of pathologists, radiologists and other clinicians
- No. of procedures and diseases such as cancer are **increasing**
  - Only way to solve it is through **technology**
- Even though healthcare industry is worth **$8 trillion** only 20% of people have **access to quality healthcare** - Need for value based healthcare
- Healthcare industry is going towards **data driven approach** - Digitization
- The amount of personal health and population healthcare data that is available today is growing at rapid speed.
- Personalized treatment

https://www.healthcare.digital/home/tag/%248%20Trillion%20Healthcare%20Industry

https://abcnews.go.com/Health/Healthday/story?id=4509618&page=1

Analytics in Healthcare



https://services.harman.com/blogs/Healthcare-Analytics-is-finally-coming-of-age

Type of Healthcare data

Type of Data	Healthcare Data
Numerical	Blood reports
Categorical	Medical test results
Text	Medical reports
Image	X-ray
Video	CT, MRI, Ultrasound output
Speech	Doctors and technicians discussions and instructions
Signals	ECG, EMG signals

Sources of Data

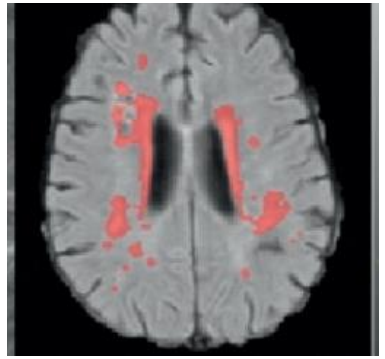
Analytics data is collected from:

- Clinical data
  - From electronic medical records (EHRs)
  - Medical reports
  - Images and data from Modalities such as X-Ray, Ultrasound, CT and MRI - DICOM format
- Pharmaceutical - research and development (R&D) data
- Hospital management
- Claims data

Top analytics use cases in Healthcare (1/4)

1. **Faster Diagnosis:**
   - Analyzing medical images/data can often be a difficult task and time-consuming process
   - Helps doctors ***to analyze the disease better*** and provide patients with the best treatment
   - A second objective opinion

2. Medical Imaging:
   - Classification, Segmentation and quality of reconstructed image
   - Processes more images, it refines its understanding and interpretation of the information



https://applysci.com/?p=5442

Top analytics use cases in Healthcare (2/4)

3. **Early detection / warning:**
   - Pattern recognition
   - The diseases can be ***detected much earlier*** say during the regular health check-ups (corrective actions can be taken before they develop)
   - Discover symptoms

4. **Improve efficiency @ Radiology:**
   - Radiologists can spend more time with patients instead of medical reports including tele-radiology
   - ***Triage*** - pipelining the patients based on their criticality
   - ***Workflow improvements*** with radiology as a service
   - No misdiagnosis

http://trdrp.yes4yes.com/priorities/diagnosis.php

Top analytics use cases in Healthcare (3/4)

5. **Personalized treatment:**
   - Everyone's health recommendations and disease treatments are tailored based on their ***medical history***, past conditions, diet, stress levels & similar patients
   - ***Optimize treatment options*** based on person's medical history

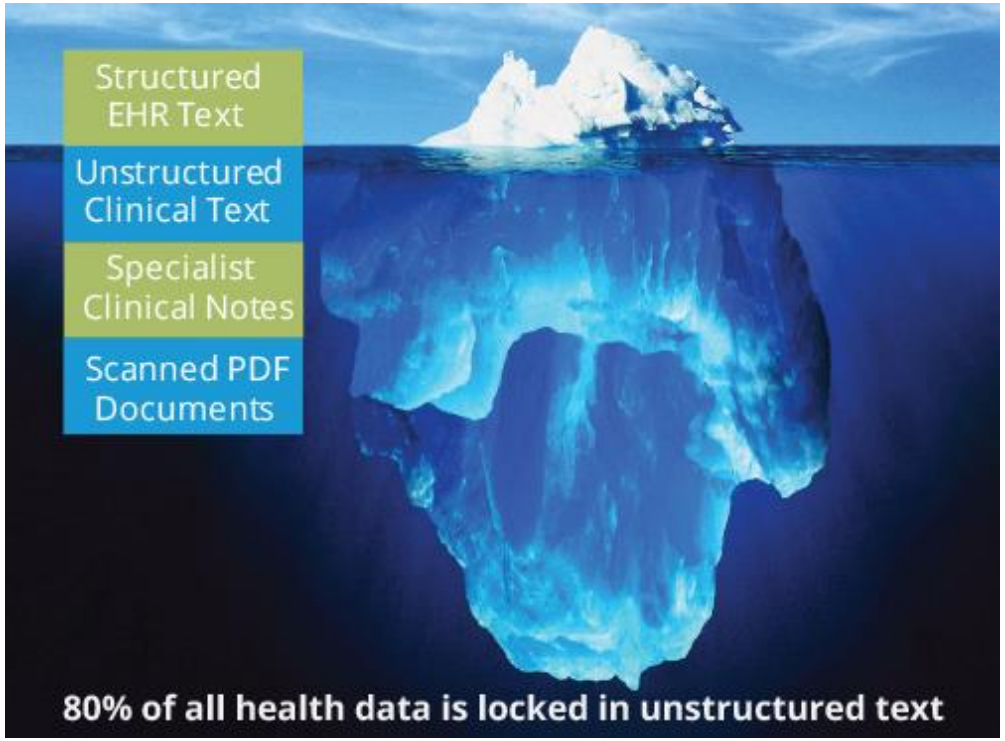
6. **Population health:**
   - Build models based on ***population data trend*** of pooled consumer data

http://www.cancer.ca/en/research-horizons/a/1/b/personalized-medicine-is-transforming-cancer-treatment/

https://www.sollis.co.uk/sollis-insights/population-health-management

Top analytics use cases in Healthcare (4/4)

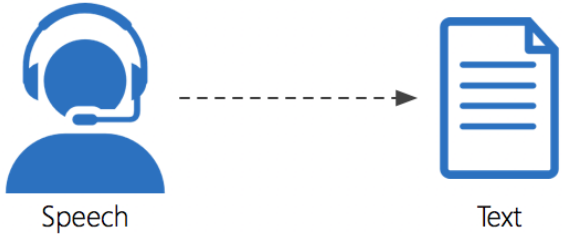
7. **Information extraction:**
   - From clinical Notes using NLP to ***anonymize, annotate, to do semantic analysis and inference***
   - Build chat bots

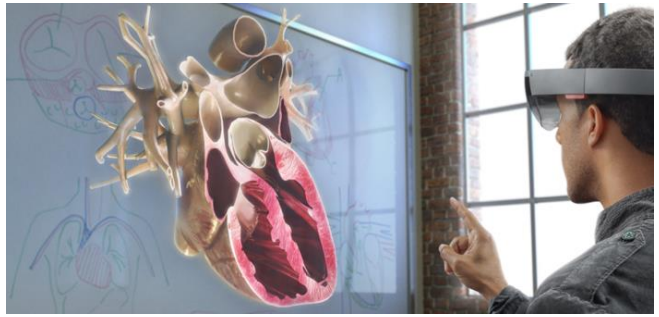


https://www.carecentra.com/clinical-notes-mining/

Supporting Technologies

Analytics play role in ***Pharma*** and ***Insurance*** industries to improve the process of clinical trails, Insurance - treatment vs claims validation, Personalization and prediction of fraud claims



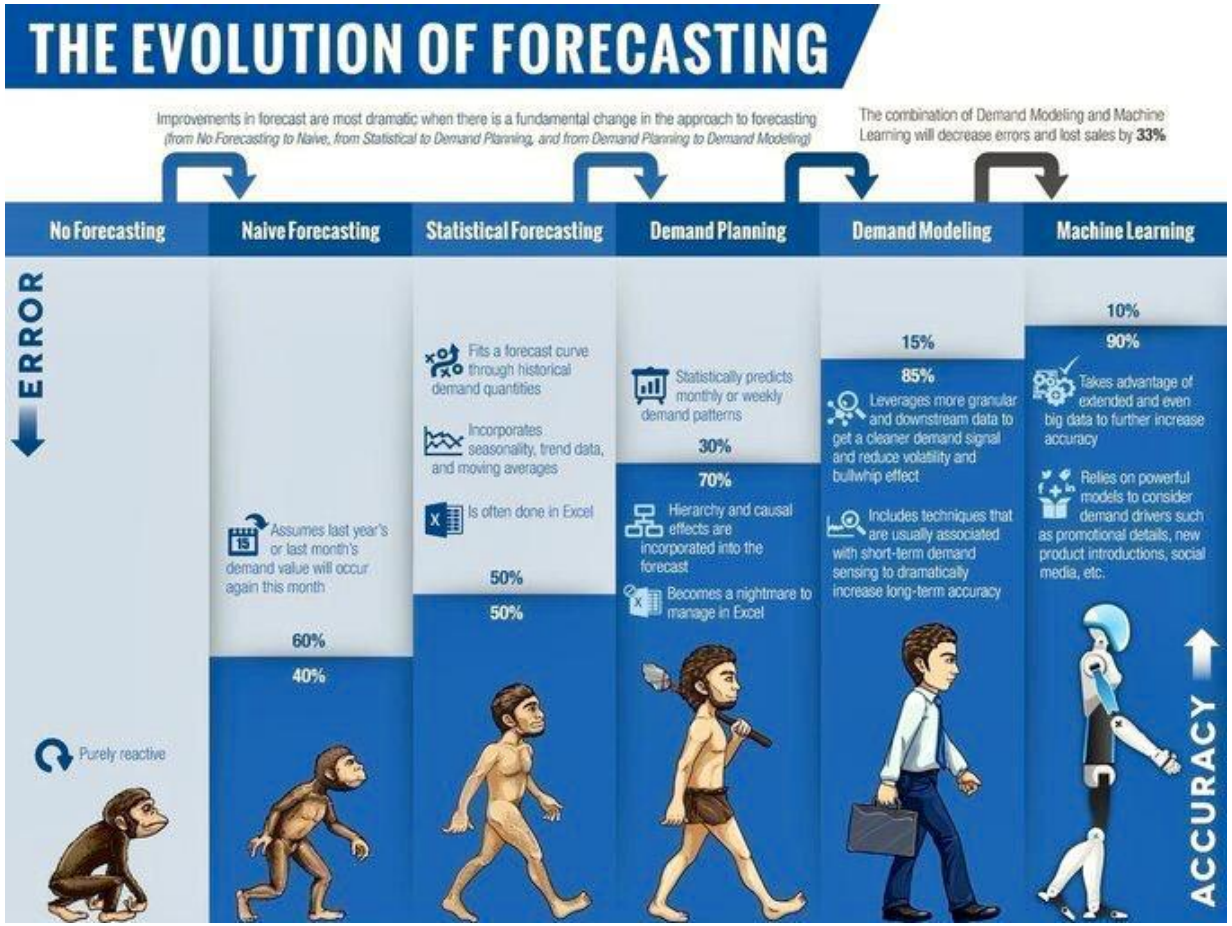


http://www.affinityvr.com/healthcare-using-augmentedreality/
https://www.sociallyawareblog.com/2016/03/17/hipaa-and-health-care-apps-is-your-app-covered/

Type of healthcare data and applications

Health care Data	Type of Data	Pre processing Steps	Healthcare Applications
Blood reports	Numerical	Normalization of the data	Classification of normal/ abnormal
Medical test results	Categorical	Encoding	Classification of normal/ abnormal
Medical reports	Text	Count vectorizer, TF/IDF	Automatic Report generation, Summarizing medical report
X-ray	Image	Image Normalization	Classification, Segmentation
CT, MRI, Ultrasound output	Video	Slices	Classification, Segmentation and object detection
Doctors and technicians discussions & instructions	Speech	Speech to text conversion	Capturing speech and generate report
ECG, EMG signals	Signals	Signals to vectors conversion	Classification of normal/ abnormal

#1. Predictive analytics



Predictive analytics

Predictive analytics is the process of learning from historical data in order to make predictions about the future

For health care, predictive analytics will enable the **best decisions** to be made, allowing for care to be personalized to each individual.

Doctors make **data-driven decisions** within seconds and improve patients' treatment.

Useful in case of patients with complex medical histories, suffering from multiple conditions.

One example:

- New tools are able to predict, who is **at risk of diabetes,** and thereby be advised to make use of additional screenings or weight management.

Personalized medicine

Traditional Approach:

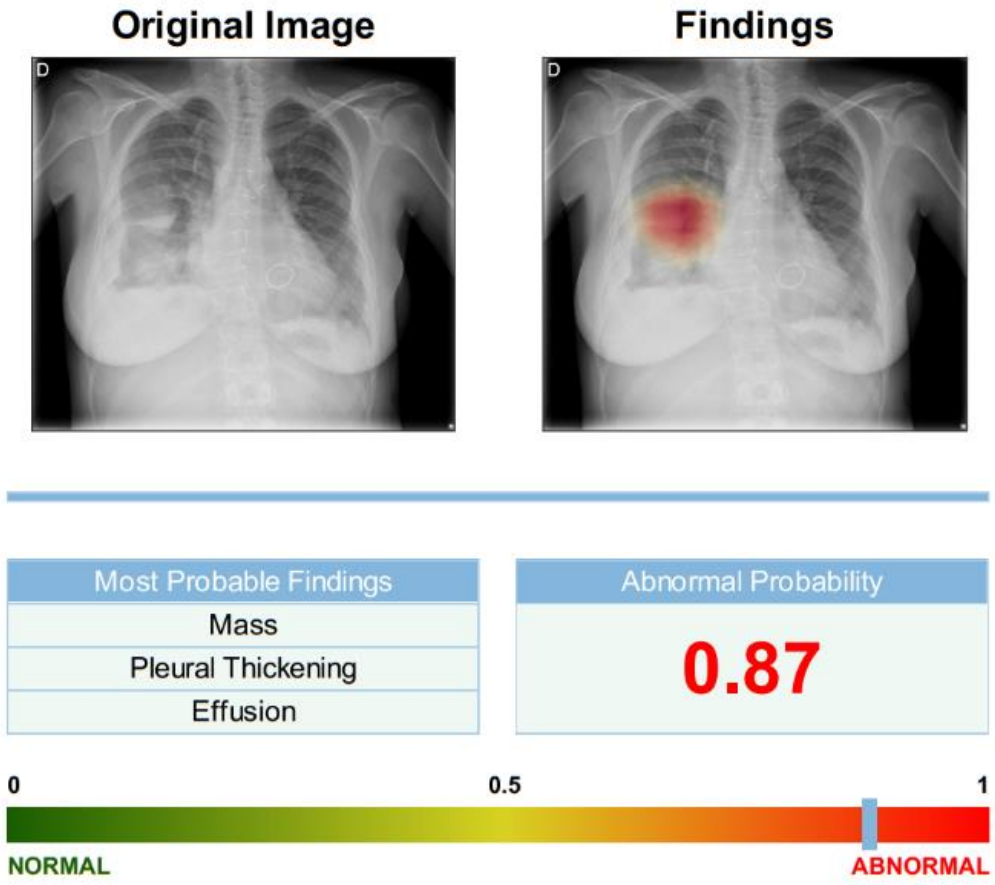
- Only dosage change is considered.
- *No quantitative measure* and monitoring of underlying life-style changes
- Does not utilize historical information effectively
- ARIMA kind of models are used from statistics
- Usage of home monitored clinical parameters + quantitative Life style parameters for caregiving
- **Two step prediction:** Clinical Parameter as well as Optimal dosage need

#2. Classification of Chest X-Ray

- The objective is classification of X-ray – abnormal vs normal

- Use analytics to identify the abnormal cases
- Use the data for triaging

- Can be extended to Machine Learning approach with availability of large amount of data



http://quibim.com/2018/07/16/new-chest-x-ray-classification-tool/

Challenges

- **Acceptance** of physicians:
  - Trust towards technology
  - Clinical validation
  - Repeatability of results
- **Fear of replacement**
  - Complement
- Reach of **quality** and diversity of data for building models
  - Data access issues across countries/hospitals
  - Region specific data residency and privacy laws also limit the sharing of patient data
- The **regulatory** environment
  - Approvals
  - Slow adoption

Healthcare Analytics platforms

- IBM Watson
- Google’s DeepMind
- GE Predix
- Philips Health Suite
- Siemens Syngo Via etc...

Future Scope

Approval to use the analytics to come to mainstream

- FDA approvals
- Autonomous robotic surgery

Prevention is better than cure – ***shift left*** strategy to mitigate the damage

- If person fall sick, that is revenue generation for hospitals
- Get an insurance premium and protect the person not falling sick – new revenue generation method

Wide acceptance of technology by the doctors

- Efforts are on to include AI subject in MBBS. Bridging the gap
- Technology is complementing the doctors

"**Second opinion** by Software for diagnosis - a trend in 10 years" – Dr. Devi Shetty

Summary

- Huge potential for analytics in healthcare applications
- Covered top use cases
- Passing through the approvals is major challenge
- Democratization
- Developments such as speech to text, IoT, AI are boon to disrupt the healthcare

Looking forward to live in better world with affordable healthcare through technology

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