Oncology - Cancer ~~treatment~~ treatment & diagnosis.
Consortium - Association of several companies.

OHSL Breast Cancer Data Alliance

24.5% of all Cancers.
Asia has 45.4% of these.
Asian female under 45 is 52.9%.
↳ Mortality rate for this group is 51.4%.
US: 34.9% & 45.6% for under 50 years.

} More stats on ohsl.us.

{ Big Data - Large & Diverse Collection of data that grows over time.
Precision Medicine - Leverages big data for medical predictions.

↳ For medicinal purposes, got from insurance claims, cancer registries & electronic health records

* Some ex. of big data used in breast cancer related precision:-
- MammaPrint { assesses activity of certain genes to determine risk of recurrence in 10 yrs
- Oncotype DX { Similar to MammaPrint.
- Pam50-based prosigna { Also Calculates Risk of Recurrence
- Endo Predict { Also calcs distant recurrence within 10 yrs.

* BCDA's goal is to bring clinical & non-clinical professionals together to identify key parameters, which could explain current trends in BC.

* OHSL is trying to create a data catalog. Collab with Alations to use their techo for this.
↳ Data management platform for corpos.

"The Data Catalog provides users with a simple, searchable & unified resource that enables data discovery, no matter the source original loc".

NCD - non-communicable diseases (like BC etc.)

* Focusing on identifying unique features for region specific breast cancer.

OHSL has 3 main goals with BCDA:-

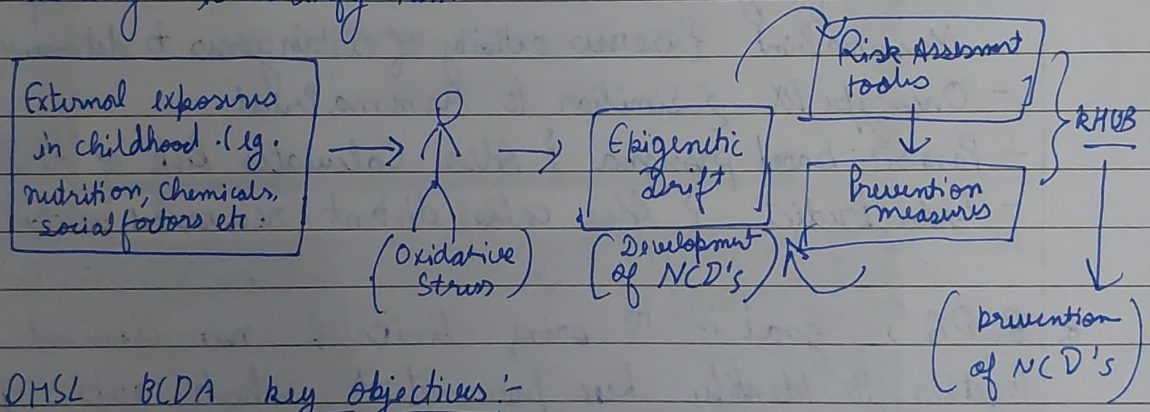
i) implement personalized preventive interventions in pre-adolescents

ii) develop a multidata knowledge hub (KHUB) included with multidata catalog to identify BC risk factors & make evidence-based recomendations.

iii) validate biomakers of Oxidative Stress ~~modified~~ mediated epigenetic impact & breast cancer risk & measure the impact of intervention in a preadolescent population

Chemical modific^n to genes.

→ imbalance b/w product^n of complex oxygen species & bodys ability to detoxify them.



* OHSL BCDA key objectives:-

↳ Data Catalog Creation
↳ Data Classificat^n & Analytics
↳ Focus on LMIC's. (Lower-Middle Income Countries)
↳ Primary Prevention.

→ Normaly help protect us from certain cancers.

READING REVIEW

Breast Cancer: An up to date review & future perspectives
- Ruoxi Hong | Binghe Xu.
- When doctors treat breast cancer, they consider:
  → specific molecule involved (like HER 2, estrogen & progesterone receptors)
  → gene mutations like BRCA1/2.
  → how immune system interacts with cancer.
- For early stage cancer, treatments like surgery & radiations are often used to remove or destroy cancer. Doctors might give medicine before surgery to shrink the tumor, which makes it easier to remove.
- For advanced cancers (like adv. BC), it is much harder to cure; but treatments like hormone therapy, targeted drugs & sometimes immunotherapy can help slow down cancer's growth.
- Doctors give tailored prescriptions to each persons specific cancer. (less or aggressive treatments)

↳ In BC, using precision medicine current strats are based on molecular subtyping, allowing for tailored therapies. Treatments can become even more individualized, with therapy adjusted acc. to tumor biology and early predictive markers. + Further classific" of BC subtypes

→ 2 Significant Questions Remain :-
↳ weather breast surgery can be avoided in patients achieving a complete pathological response (pCR) after neoadjuvant therapy.
↳ Shrinking a tumor. {incl. chemo, radiation, hormone therapy.

↳ If some patients can skip axillary surgery for staging & treatment.
Removing lymph node ← from armpit area.

Mammography:- X-ray imaging method used to imagine the breast for early detection of cancer & other breast diseases.

DCIS: Ductal Carcinoma in-Situ is a condition that affects milk ducts in the breast.

The Breast Cancer Landscape:

- Department of Defense Breast Cancer Research Program.

Breast Cancer Incidence:-

↳ Likelihood of a woman being diagnosed with breast cancer has increased from 1 in 11 in 1975 to 1 in 8 today.
partly because more woman are reaching older ages.

↳ But, could be due to screening pratices & use of hormone replacement therapy } changes in. & like mammography.

↳ Introduction of mammography has led to increase in DCIS.
DCIS went from 2% (1985) → 33% now.]]
(Abt 31% are considered overdiagnosis) Concern About overdiagnosis & overtreatment.

Breast Cancer Deaths:-

* Most BC Deaths occur because the cancer spreads to other parts of the body, affecting vital organs like lungs, liver & brain.

- While breast cancer incidence varies globally due to screening practices, mortality rates are consistent across regions.

Risk Factors:-

(↑Risk >4X)	(↑Risk 2X-4X)	(↑Risk upto 2X)
High-Risk Factors	**Moderate R.F**	**Modest R.F**
- Age (65+ versus <65 yrs)	- Prior diagnosis of DCIS	- Alcohol Consumption.
- Presence of pathogenic genetic variations (BRCA1, BRCA2, ATM, CHEK2, PALB2, TP53)	- High endogenous hormone levels (postmenopause)	- Early Menarche (<11 yrs) (premenopausal)
	- High-dose radiation to Chest.	- Late age first pregnancy
	- Mammographically dense breast.	- Late Menopause
- Diagnosis of atypical hyperplasia &/or lobular C-I-S.	- Having 2 or more relatives with B.C.	- Never breastfeeding a child.
		- No full-term pregnancy.
		- Obesity & physical inactivity
		- Tall height.

Receptors in or on cells that can attach to certain substances in blood. { ER- Estrogen Receptor
PR- Progesterone Receptor
HER2 -- human epidermal growth factor-receptor 2

↳ Still not all breast cancer cases can be attributed to these risk factors. Some factors like age, fam. history, & genetic mutations are not modifyable.

↳ Radiation exposure especially during childhood is a well established risk.

↳ ~~Advanced~~ Risk factors may vary in their relationships to different molecular subtypes.

~~Heterogeneity~~ Heterogeneity:-

Subtypes of BC:-

↳ Luminal A:- +ve for either ER or PR, but -ve for HER2

↳ Luminal B:- Similar to Luminal A but higher proliferation rates & maybe ~~HER2~~ HER2-positive.

↳ HER2-overexpressing:- -ve for ER or PR, but +ve for HER2

↳ Basal Like (Triple Negative):- Negative for ER, PR & HER2.

Distribution of these varies by factors like age, race, ethnicity etc.
- No targeted therapies are available for patients with triple Negative BC.

Recurrence:-

- Around 10 to 30% of women may experience recurrence.
- Metastatic BC accounts for 90% of BC related deaths.
- Treatments are aimed at slowing growth instead of termination.

* Different BC therapies include chemo, hormonal, radiation therapy. There are less invasive surgeries like lumpectomy with radiat^{n} therapy, leading to improved QoL but no change in mortality rates. Newer treatments have increased the number of toxicities.

Metastatic BC:- { Spread of cancer from places where the formed for the first time to new organs.

Histopathology : Diagnosis & study of diseases in tissue

(B.T) Benign tumor has distinct, smooth, regular borders.

(M.T) Malignant tumor has irregular borders & grows faster than B.T.

Artificial Intelligence in Cancer Research

- Bhavneet Bhinder et. al.

Delves into transformative impact of AI on oncology.

1. Introduction to AI in Cancer Research

- AI encompasses a broad range of computational techniques that enable machins to mimic human intelligence.
- Dup Learning (DL), is a subset of AI, involves neural networks with multiple layers. (Hence "dup"), capable of learning from vast amounts of data.
- AI's ability of pattern recognition makes it a powerful tool in oncology.

2. Applications of AI in Oncology

2.1. Detection & Classific^{n} of Cancer

* HISTOPATHOLOGY & IMAGING

- Convolution Neural Networks (CNNs), have been successful in classifying medical images, such as histopathology slides, with high accuracy.
- Deep PATH system uses CNNs to classify lung cancer subtypes with a high accuracy, outperforming traditional methods.
- AI models can distinguish b/w malignant & benign tissues in breast biopsies, aiding pathologists in diagnosis.

* DNN's excel in classifying images such as H&E stained whole-slide images (WSI's) of tissue samples.

• TME is the ecosystem surrounding a tumor.

Inception - v3 architecture has been used to classify lung cancer subtypes with AUC of 0.97.

Used DNN to quantify lymphocyte infiltration.

2.2 Molecular Characterization of Tumors :-

- Tumor Microenvironment (TME) :-
  - > AI helps in analyzing the TME, which includes various cell types & molecular signals that interact with tumor cells. [Learning Model by Saltz et. al.]

- Genomic & Proteomic Analysis :-
  - > AI can integrate data from genomics, proteomics & other omics technologies to identify biomarkers & subtypes of cancer.
    - Study of genetic mat^n
    - identificat^n & characterizat^n of all proteins.
    - Sign of normal or abnormal process.
  - > This aids in personalized medicine, where treatments are tailored based on the molecular characteristics of the individuals tumor.

2.3 Drug Discovery & Repurposing :-

- Accelerating Drug Development :-
  - > AI algos analyze biological data to identify potential drug targets & predict the efficacy of new compounds.
  - > Ex :- DrugCell model integrates cellular & drug response data to predict how cancer cells will respond to different therapies, aiding in discovery of new treatment.

combinat^n of histological stains : hematoxylin & Eosin.

- Drug Repurposing :-
  - > AI can identify existing drugs that might be effective against cancer by analyzing molecular effects & matching them with cancer cell vulnerabilities. { This shortens time & cost consumption.

Immunotherapy :- Using persons own immune system to fight cancer.

2.4 Predicting Treatment Outcomes.

- Personalized Treatment Plans :-
  > AI models predict how patients will respond to various treatments, helping to tailor therapies to individual patients.
  > Example: A study by Durcl et al. used ML to analyze CT scan features & predict lung cancers' patients' responses to immunotherapy.

Another ex :- use of CNN's by choi et al. to predict response to chemotherapy.

- Survival Predictions :-
  > AI can analyze patient data, including medical images & clinical records, to predict survival outcomes & guide treatment decisions.
  > This helps in managing patient expectations & planning appropriate interventions.

3. Challenges & Future Directions :-

3.1. Data Quality & Availability.

This is basically what OHSL-BCDA project is aimed to contribute at via a comprehensive catalog

- Large, Annotated Datasets.
  > AI models require large datasets with accurate annotations for training. Access to high-quality data is often an bottleneck.
- Data Privacy & Security.
  > Ensuring patient data privacy & security while sharing data for AI research is crucial.

P.T.O

we can't trace the systems thought - process.

3.2 Model Interpretability:-

- Understanding AI decisions:-
  > Deep learning models have a 'black-box' nature, making it difficult to interpret their decisions.

- Regulatory & Clinical Acceptance:-
  > AI models must be interpretable & comply with regulatory standards.

3.3 Continous learning & Drift:

enabling detailed studies of cell interaction within the TME.

- Concept Drift:
  > AI models need to be updated continously as new data becomes available & medical practices evolve.
- Maintaining Performance:-
  > Ensuring models retain performance over time requires validation & retraining.

4. Technological Advancements:-

4.1 Advanced Imaging Technologies:-

> Combining AI with advanced imaging tech like multi-modal imaging [e.g. combining MRI & PET scans] can improve diagnostic accuracy & provide more comprehensive insight into tumor biology.

MRI:- Magnetic Resonance Imaging.
↳ Detailed images of inner structures.

PET:- Positron Emission Tomography (P.T.O)
↳ Helps reveal metabolic or biochemical functions.

4.2 Integrative Approaches :-

> Integrating data from various sources can provide a holistic view of the patients condition & improve decision - making.

5. Conclusion.

- Transformative Potential :-

> AI has potential to revolutionize oncology by improving diagnostic accuracy, personalizing treatment, accelerating drug discovery & predicting patient outcome.

> Overcoming current challenges related to data quality, model interpretability & continous learning is essential for fully realizing AI's benefits in cancer care.

What BCDA is aimed at.

- Future Outlook :-

> Future looks promising with ongoing research & tech. advancements expected to further enhance its applic^{n} & integrat^{n} into clinical proc.

> Collab. b/w researchers, clinicians & regulatory bodies will be crucial in driving successful implementation of AI in oncology.