

# AI & Healthcare In The Low and Middle Income Countries

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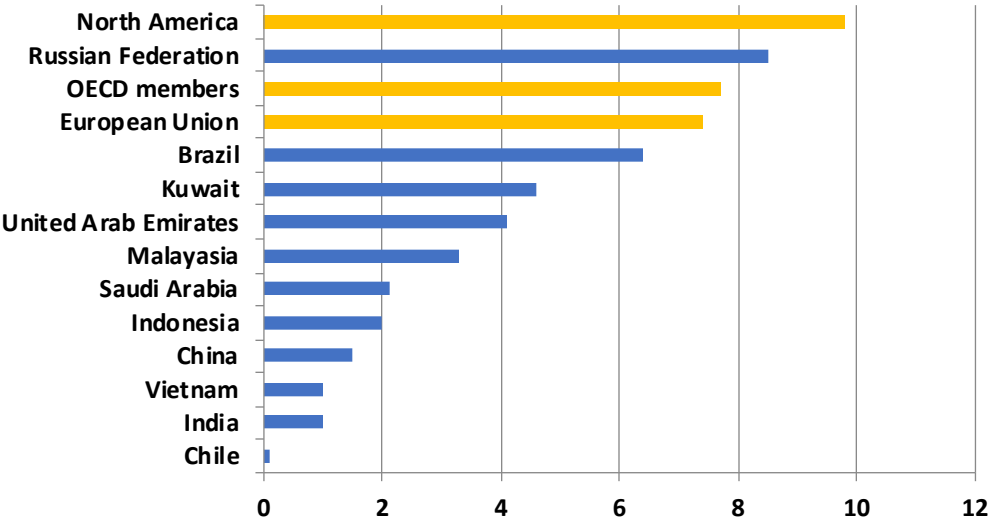
## HGHI AI Program Focus

Opportunities & challenges in applying AI driven technologies in healthcare in the LMICs

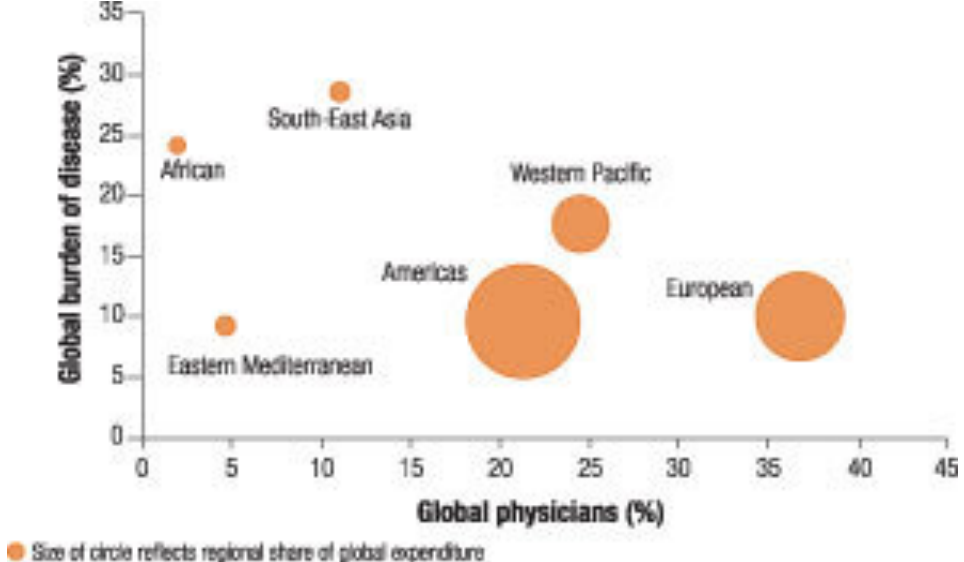
- Convene across Harvard
- Research
- Policy
- Education

# Challenges in Healthcare Delivery In The LMICs

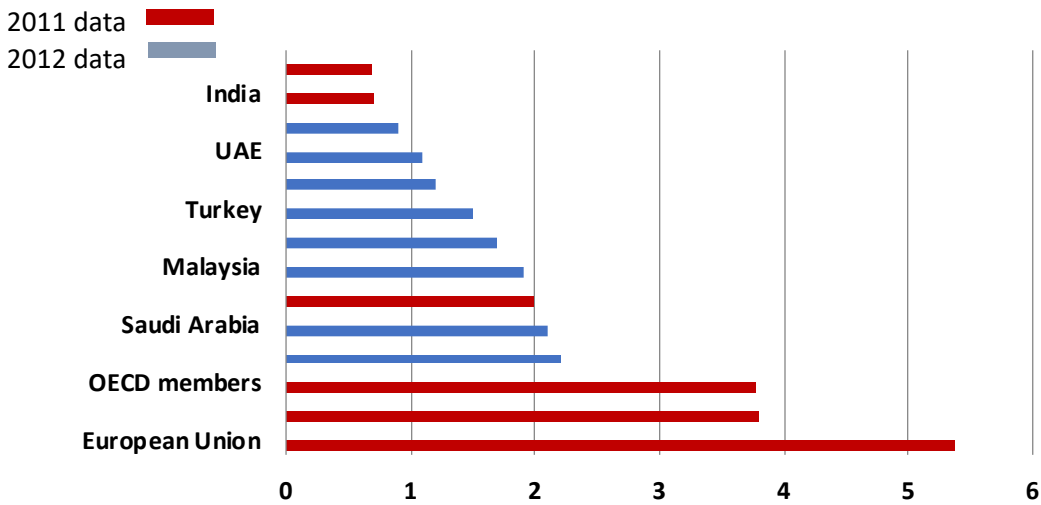
### Nurses per 1000 in 2010



### Global Physician% v/s Global Disease Burden



### Hospital Beds per 1000 Population

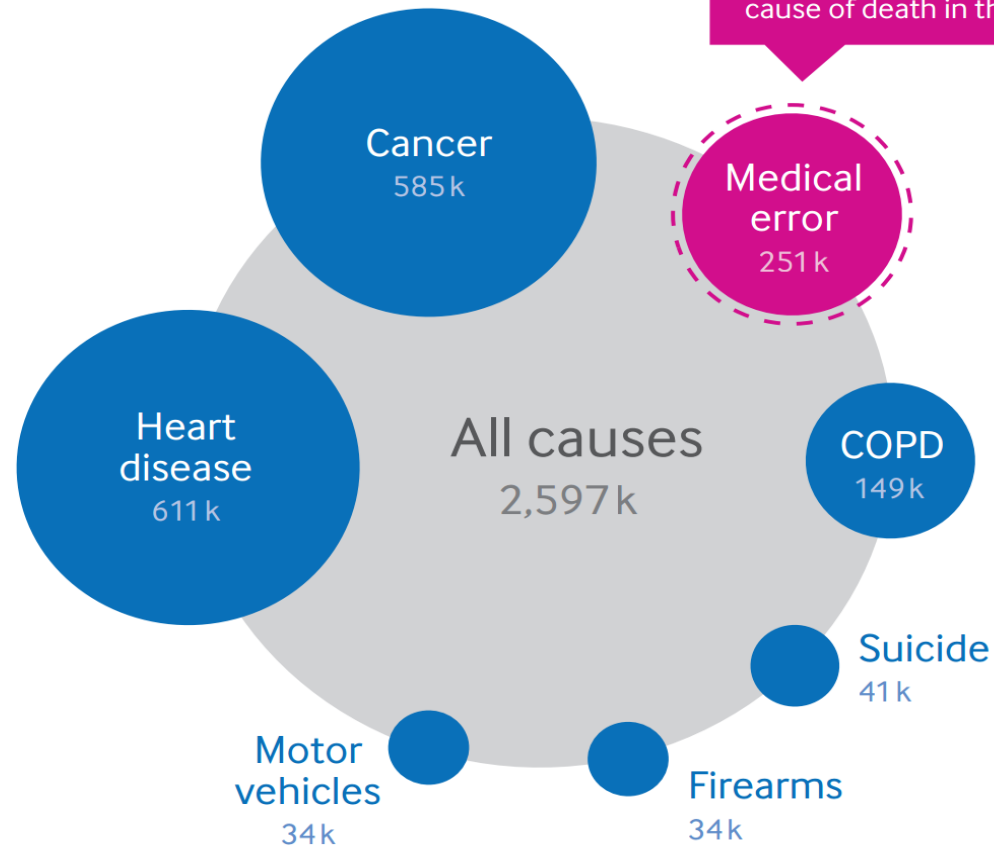


*Quality Gaps Are Significant in the LCMI's And Addressing These Are Critical to Achieve Any Sustainable Development Goals.....*



- Ineffective care in the LMICs was responsible, on average, for 25% of deaths caused by the conditions examined*
- Nearly 1 in 5 hospitalized patients who went to the hospital were harmed in the process. Overall, 134 million adverse hospital events occurred, leading to approximately 2.6 million preventable hospital deaths annually*
- Over 120,000 HIV patients who are connected to treatment end up dying from substandard and falsified medicines every year*

## Causes of death, US, 2013



However, we're not even counting this - medical error is not recorded on US death certificates

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**Data source:**

[http://www.cdc.gov/nchs/data/nvsr/nvsr64/nvsr64\\_02.pdf](http://www.cdc.gov/nchs/data/nvsr/nvsr64/nvsr64_02.pdf)

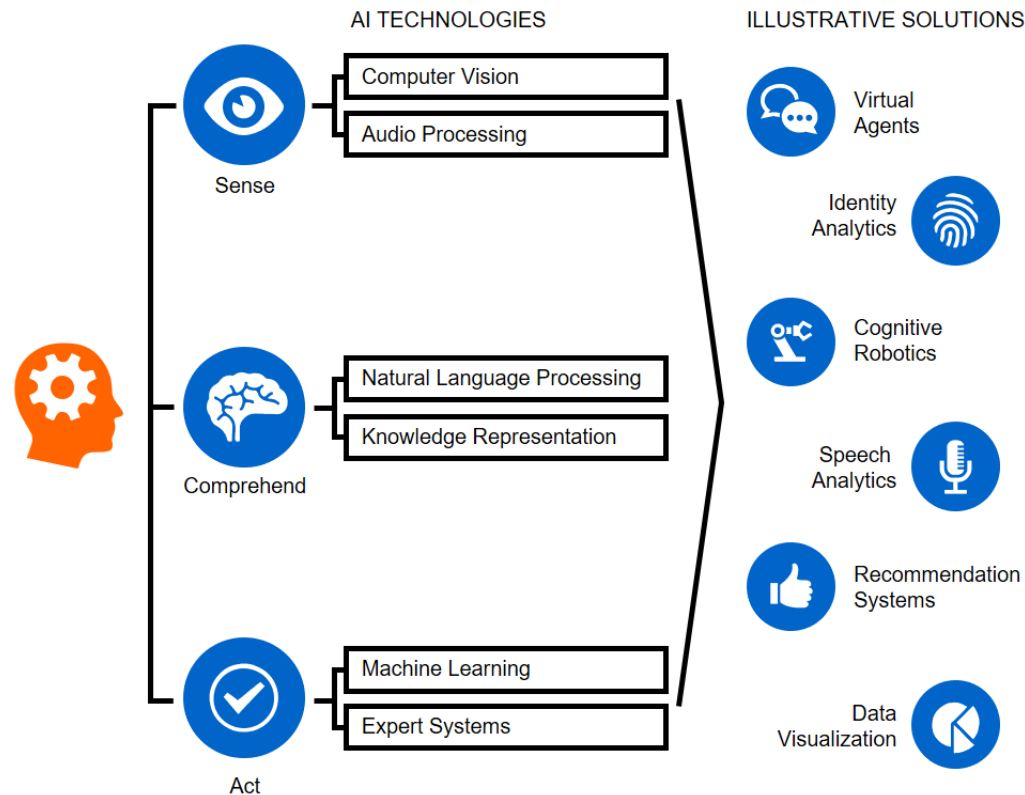
# The Promise of AI For The LMICs

10X increase in medical data by 2025 to  
163 zettabytes  
*IDC forecast*

BUT

- Existing & valid data sets?
- Data fidelity?
- Data Security?
- Data bias?
- Protection of personal information?
- Data curated?

Emerging AI technologies



- Prevention & Wellness
- Screening
- Quality & patient safety
- Dx & Prognosis (POC-Telemedicine)
- Skill Shifting
- Clinical Decision Support
- Predictive Analytics
  - NCD & PHM
  - Pandemics, epidemics
  - Chronic Disease Management
- Research
- **Education, Upskilling and Skill augmentation**

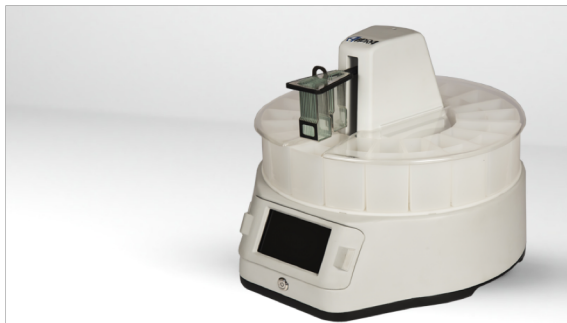
# Focused Use Case: In Cervical Cancer

Problem: High prevalence of undiagnosed cases in India estimated at 1-1.4M cases annually; inadequate cytopathologists; poor tissue acquisition; poor staining quality;

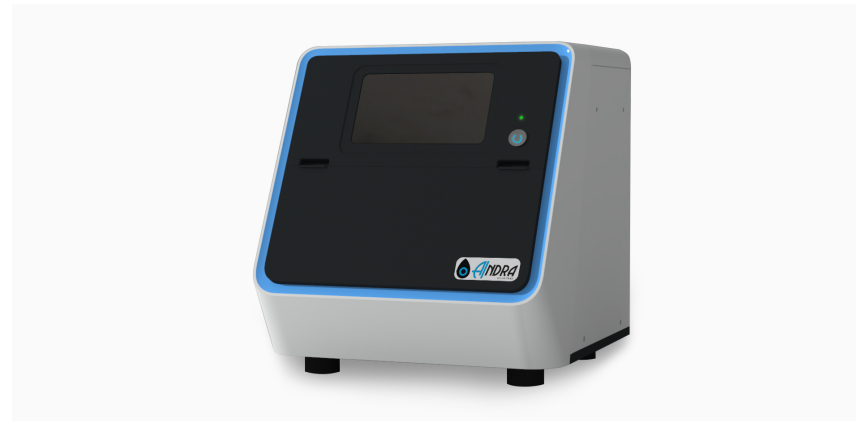
Approach: Computational Pathology -A/ndra

Verification By A Cytopathologist

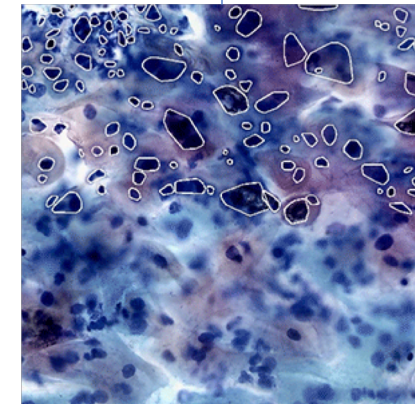
← Closed Loop Solution →



Staining



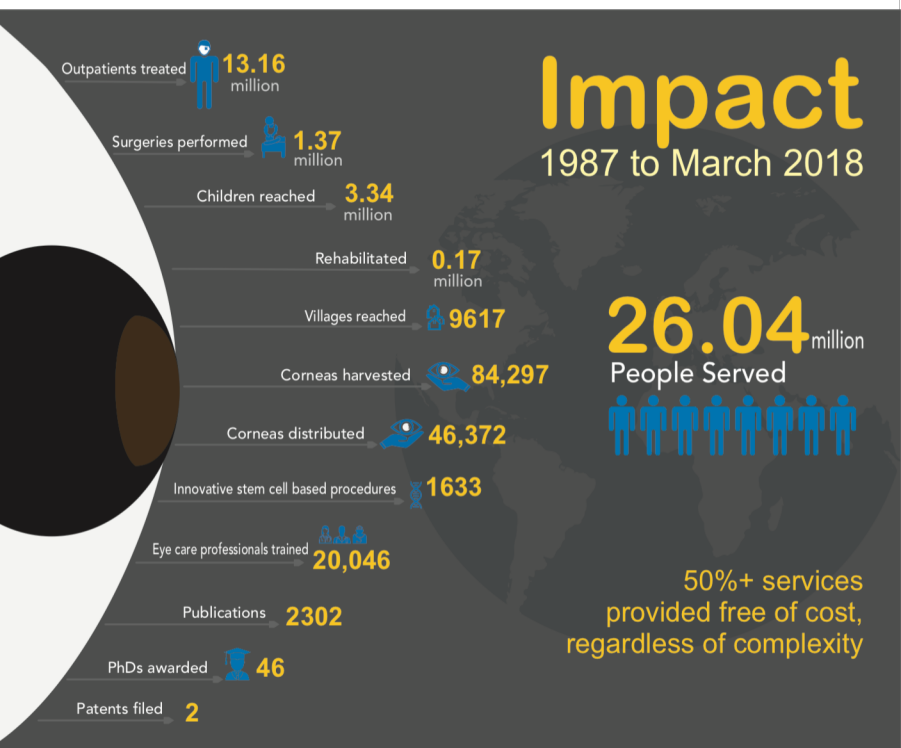
Digitization



Diagnosis & Predictive Assessment  
Edge Neural Net, Trained over 100s of  
verified, curated & labelled samples

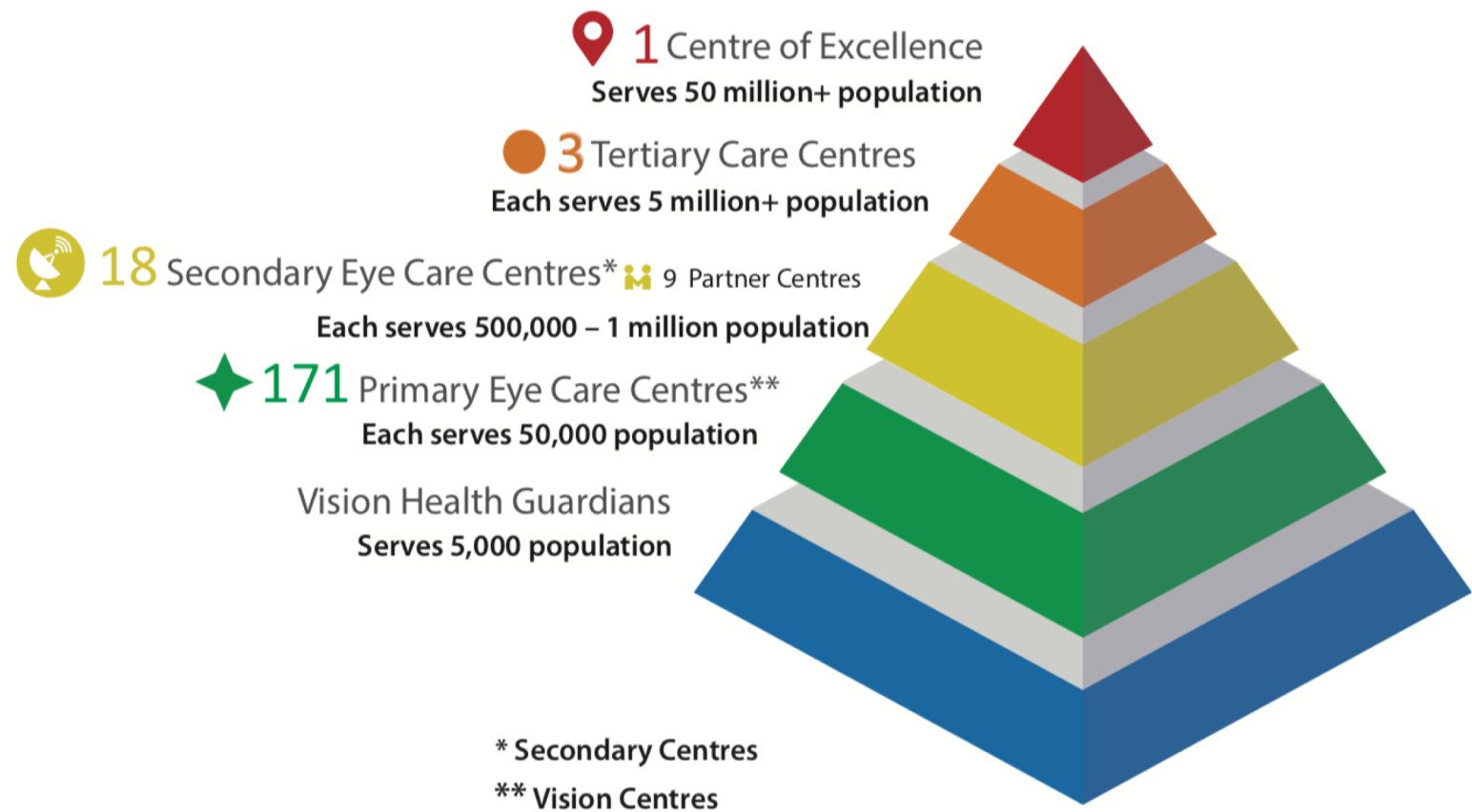
But Issues: Treatment of Dx Patients; Cost of Rx; Cytopathologists' acceptance

# Use Case: System Wide Scaling LVPEI



Done with 78 Ophthalmologists

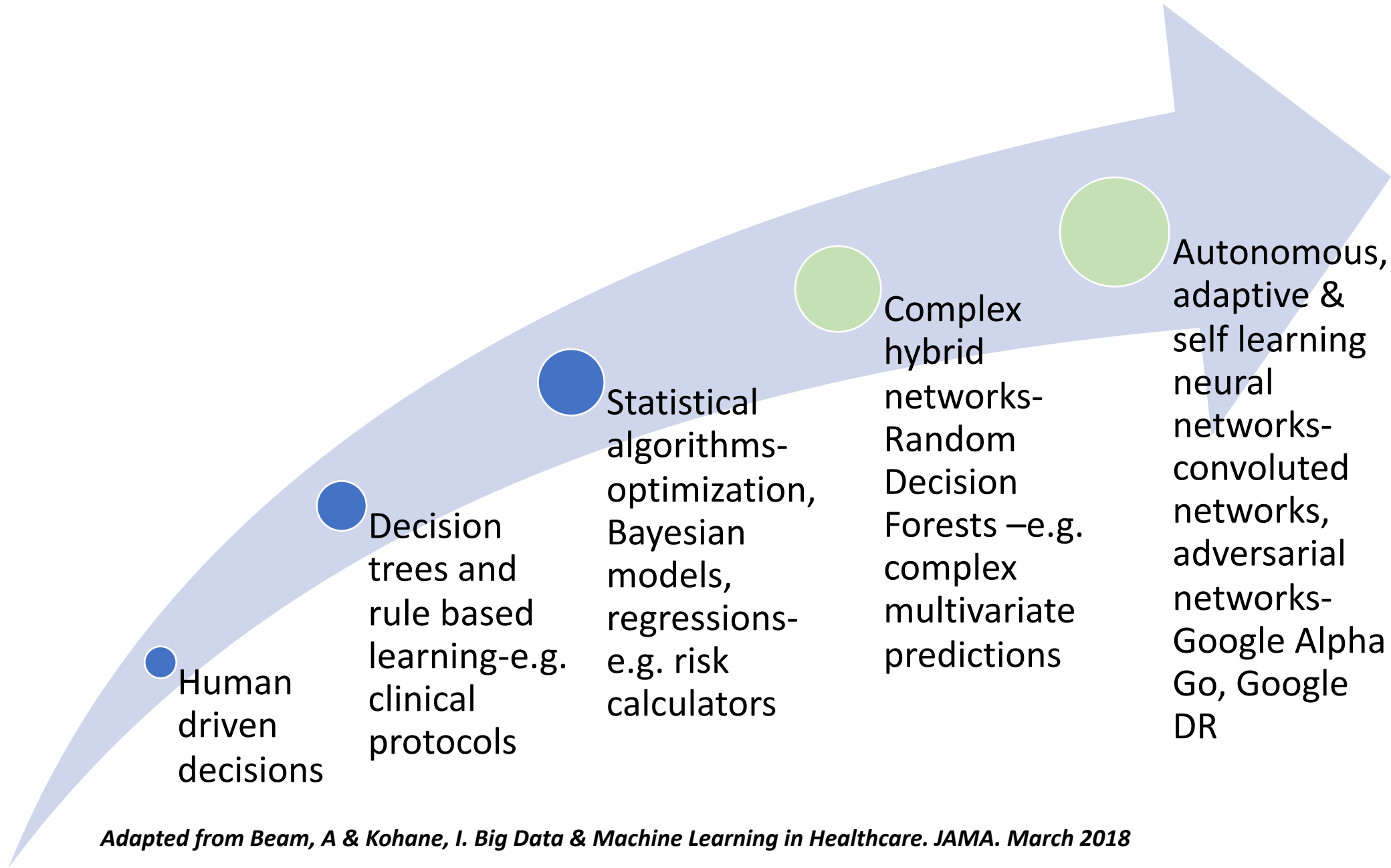
Total Centres: 195



Core Technology I-Smart-Ophthalmic EMR based clinical decision trees

AI driven predictive algorithms only for one selected area – future refractive error onset prediction

# Simplified AI-Machine Learning Framework To Consider For LMICs



# Implementation Issues To Consider

| Issues of Impact                                              | Human Decision Making | Decision Trees | Statistical Algorithms | Hybrid - Forest Decision Trees | Neural Nets                   |
|---------------------------------------------------------------|-----------------------|----------------|------------------------|--------------------------------|-------------------------------|
| Human Control                                                 | N/A                   | Yes            | Yes                    | Moderate                       | Low, Black Box                |
| Data Needs & Computing Power                                  | Low                   | Low-Moderate   | Moderate               | Moderate-High                  | Very high                     |
| Data Bias Concerns                                            | N/A                   | Present        | Present                | Moderate                       | High                          |
| Legal Precedence                                              | Established           | Present        | Present                | Early                          | In its infancy                |
| Need for Meta Data Veracity, Security, Fidelity and Labelling | Nil                   | Yes            | Yes                    | Yes                            | Significant                   |
| Augment v/s Supplant HR skills                                | N/A                   | Augment        | Augment                | Augment                        | Augment but Supplant concerns |
| Issues around Ethics, Equity                                  | N/A                   | Possible       | Possible               | Possible                       | High                          |
| Implementation & Adoption Hurdles                             | N/A                   | Low            | Low                    | Moderate                       | High                          |

# Framework : Matrixed Systems Evaluation

## AI/Machine Learning Driven Technologies & Impact On Healthcare Delivery

### ***Quality Of Care***



- Improves Dx & Rx? If so for what types of conditions?
- Enhances/improves outcomes?
- Improves standards and consistency of care?
- Adaptable to local demographics?
- Guides better decision making?
- Improves care delivery?
- Scalable?
- Provides better predictive assessment?

### ***Access To Care***



- Improves access to the urban poor and rural settings, if so how?
- Address HC professional gaps, skill shifting, up skilling, maldistribution?
- Changes the existing care delivery system, how?

### ***Economics***



- Economic sustainability in care delivery?
- Improves affordability?
- Lowers utilization of resources and cost?
- Unmasks latent pools of undiagnosed cases? If so Impact on the existing health care economics?

**Apply To These The Cross Cutting Issues**

**Ethics; Legal Frameworks; Data Related Challenges ; Validation; Efficacy-Quality of Life; Adoption & Implementation**

Framework : Map The Environment

