Artificial Intelligence for Social Good: Our Approach at Wadhwani AI

P. Anandan
Sep 13, 2018

Wadhwani AI
AI FOR SOCIAL GOOD
Wadhwani Institute for Artificial Intelligence (Wadhwani AI) is an independent, nonprofit research institute and global hub for developing AI solutions for social good.

Our mission: AI for ALL
Tech Entrepreneurs Dr. Romesh Wadhwani and Mr. Sunil Wadhwani are committing $3M/year for 10 years (total $30M) as well as their own time and the benefit of their entrepreneurial experience.
Our main goal is to develop AI solutions to benefit the underserved billions in developing countries, in domains including:

• Health
• Agriculture
• Financial inclusion
• Language
• Infrastructure
• Education
Wadhwani AI launched on Feb 18 by the Hon’ble PM of India Shri Narendra Modi
OUR MISSION

Innovate
- Create innovative solutions to Societal Challenges based on Artificial Intelligence and related technologies

Impact
- Deploy the solutions in underserved communities through Government programs and the efforts of non-Governmental organizations

Catalyze
- Catalyze AI for social good innovation by being a hub where researchers and agencies from across the world collaborate in solving societal challenges

Pioneer
- Become the world’s leading applied research institute focused on AI for social and economic good
UNIQUE APPROACH
Our AI researchers work alongside diverse team members: data scientists, engineers, designers, product managers, domain experts, partnership managers, and entrepreneurs.

PARTNERS AND CHAMPIONS
PATH, Gates Foundation, WISH Foundation, and Government of India are among our early partners and champions. Researchers from Stanford, USC, University of Washington, and NYU are among our research partners.
Our Initial Focus Areas

- **TUBERCULOSIS**
- **FRONTLINE HEALTH**
- **COTTON FARMING**
Frontline Health
September 2018

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Frontline Health: Background

- Primary Health resources: 27k PHCs and 150k Sub-centers, with 32k doctors, 250k ANMs and 1 million ASHAs form the frontlines
- Govt wants to upgrade existing facilities to 150k tech-enabled Health & Wellness Centres (HWC)
- Opportunities to:
  - overcome skill gaps
  - expand care beyond mother-and-child, cope with workload
  - digitize measurements and tests
  - connect the data dots
- Partners: WISH, Gates
Frontline Health: Journey to date

**Early exploration (Mar-July 2018):** Identified a list of initial use cases based on research and interviews. Interviewed creators of (or surveyed) apps used by primary health workers in India (e.g., CAS, Mobile Kunji, etc.) and globally (Ada, Babyl, Blackwell)

**Field research (June 2018):** Team members visited rural PHCs and Sub-centers managed by WISH

**Initial use case:** Advisory app for frontline workers

**WISH/Gates/ Wadhwani AI workshop (August 10th 2018):** Led a day-long workshop to generate ideas for AI solutions in primary health, with inputs from the field, program and systems levels

**New use cases:** Identified and prioritised three new use cases after workshop

- Detection & management of high-risk pregnancy (*Ongoing*)
- Anthropometric imaging for growth tracking (*Ongoing*)
- Triaging app for frontline workers

**Upcoming workshop at Gates Bihar Partners Meet (Sep 20-21 2018):** Conducting a second AI-focused workshop to generate deeper insights and identify specific solutions
High-risk pregnancy (HRP): Solution Areas
Possible solutions mapped to hypotheses

No ANCs or check-ups, hence HRP is never detected
E.g., Geotagged HRP hotspots using socioeconomic indicators + satellite imagery for better last-mile outreach

Some ANCs happen but HRP is not properly detected in time
E.g., Tools for better early outreach, HRP Diagnostic kit for ASHA + AI-powered ultrasound + App to calculate a risk score / risk vector

HRP is detected but not managed in the antenatal period
E.g., Geotagged reminder / alert system for regular follow-up with high-risk pregnant woman

HRP is detected but not managed during childbirth
E.g., “Capacity + logistics planning” for PHCs and First Referral Units (FRU) for childbirth

Leading hypothesis

Hypothesis #2
Conducted Gates+Wadhwani AI+WISH Workshop on AI for Public Health (Aug 10th)

• Day-long workshop (10 AM to 6 PM) at the Gates Foundation office on August 10
• 27 participants across seniority levels: from field staff at WISH to country leads at Gates
• Excellent participation and engagement
• Identified over a dozen broad use case areas and prioritised 5
• Buy-in from Gates and Wish Foundation
High-risk pregnancy (HRP): Overview
What makes HRP a compelling problem area

Critical Public Health Issue
- High-impact problem area with cascading effects on mother and child health and well-being
- Strong political will: aligned with UN-SDG and National Health Policy goals

Rich data
- Data collection processes in place, rich datasets available
- Individual pregnant women already tracked by ANMs, records digitised and available through the national Mother & Child Tracking System

Pathways to scale
- Strong partners in the form of Gates (rich experience and insights at the policy, strategy, and implementation levels) and WISH Foundation (deep expertise in implementation)
Anthropometric Imaging: Overview

- Anthropometric imaging identified as a high-priority need by Gates India and WISH Foundation, especially to identify low birth weight babies
- Had a preliminary conversation with Kenneth Brown (Nutrition team, BMGF Seattle) on 7 Sep to discuss the anthropometric imaging tool developed by Gates grantee Body Surface Translations (BST)
- Currently evaluating different technical approaches with a focus on accuracy, cost, and computational power
Tuberculosis Eradication
September 2018

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Tuberculosis: Background

- 2016: 2.8 million new cases, 0.43 million deaths in India
- 2016: 10.4 million new cases, 1.7 million deaths globally
- 2016: DR-TB cases grew 13% from 130,000 to 147,000 in India
- Indian government target: eliminate TB by 2025
- WHO target: eliminate TB by 2050
- Partners: PATH (and WISH)
Tuberculosis
TB is recognized as a crisis, predominantly affecting low-income populations. Drug-Resistant TB (and Multi-Drug-Resistant TB) are growing at alarming rates.

- TB affected 2.8 million and killed 0.43 million in 2016 in India.
- DR-TB cases grew 13% from 130,000 to 147,000 from 2015 to 2016
- Government has set the ambitious target of eliminating TB by 2025*

**Use-cases**
- Diagnosis through sputum slide analysis
- Decision support for Multi-Drug Resistant TB
- Treatment adherence & patient risk assessment
- Automated X-ray analysis for screening
- Outbreak prediction

**Partners**
- PATH
- Will approach Mumbai Corporation, and relevant state and central bodies as needed.

**Data & Piloting:** PATH is the leading international non-profit working on TB. Its flagship TB program is in Mumbai (in partnership with Mumbai Corporation), with support from government’s Central TB Division, WHO, and Gates. The program has patient level data and also screening and diagnostics data.

**Scaling:** PATH advises government at central level. Elements of the program are already being borrowed for national level scaling as part of RNTCP (Revised National TB Control Program).

*National health policy*
Guiding framework: The tuberculosis treatment cascade

Cascade: Path that a TB patient takes from development of active TB to incidence outcome following treatment. We structure challenges in TB by stage of cascade.

1. TB patients who do not seek out care
2. TB patients who sought care but were not diagnosed or were diagnosed but not reported.
3. TB patients who were diagnosed, but never initiated on treatment or never formally registered.
4. TB patients who died, failed treatment, were lost to follow-up or were "not evaluated.
5. TB patients who relapsed within 18 months of completing treatment.

New active TB cases (incidence) > Patients seeking care from a health provider > Accurately diagnosed with TB > Initiating first line treatment > Completing treatment > Incidence Outcome.

Drop-offs at each stage:
Losses at each stage of care cascade in public sector in India (Private sector numbers largely unknown)

- Incidence rate is declining, but not fast enough.
- Vast majority of patients seek care, but many from unreliable private providers.
- Some from private sector finally get diagnosed in public sector. Some losses as diagnostics not very sensitive.
- Improving in public sector; private sector not well understood.
- Increasing rates of multi-drug resistant (MDR) TB increasing treatment failure rates.

- Drop off and uncertainty:
  - High uncertainty in incidence number: Upper estimate up to 4.6M.
  - Loss: ~460k.
  - Loss: ~300k in public sector due to missed screening.
  - PVT sector: Unknown.

- Comments:
  - Incidence: Public sector 2.8M (52%); Private sector ~1.2M (48%).
  - Patients seeking care from a health provider (first care).
  - Initiating first line treatment: Public sector: ~1.3M; Private sector: Unknown.
  - Completing treatment: Public sector Cured: ~960K.

- Losses at each stage of care cascade:
  - 1. No care-seeking (~17%)
  - 2. Not identified as TB patient or not reported: Private sector: Unknown.
  - 4. Loss to follow-up, on treatment: Public sector: Unknown.

- Deaths: ~423k.
- Other (e.g., cured private sector).

- No robust data on private sector post care-seeking stage.

- Persons
  - New active TB cases (incidence)
  - Patients seeking care from a health provider (first care)
  - Accurately diagnosed with TB
  - Initiating first line treatment
  - Completing treatment
  - Incidence Outcome

- Summary:
  - ~40% Indians with latent TB (increasing pool), some convert into active disease.
  - Loss: ~460k.
  - Loss: ~300k in public sector due to missed screening.
  - Pvt sector: Unknown.

- Targeted interventions:
  - Improved case finding strategies.
  - Strengthened diagnostic capacity.
  - Quality improvement initiatives.

- Future directions:
  - Enhanced monitoring and evaluation systems.
  - Increased investment in TB control programs.

- Collaboration with stakeholders:
  - Health authorities.
  - Private sector providers.
  - Civil society organizations.

- Reporting and accountability:
  - Regular reporting on program performance.
  - Public health surveillance.

- Conclusion:
  - Continued commitment to TB control efforts.
  - Ongoing monitoring and evaluation of programmatic interventions.

- Acknowledgments:
  - Contributions from healthcare workers.
  - Support from donors.

- References:
  - National TB Control Program.
  - WHO TB report.
  - Local epidemiological studies.
Sputum Microscopy

considered but de-prioritized

- Automated counting of bacilli in sputum microscopy for monitoring and diagnosis has been de-prioritized as a valuable problem to work on.

Key reasons:
- Low sensitivity 60% (CI: 20-80%)
- Does not detect drug resistance
- Better tech either in early stages of deployment or late stages of development. (GeneXpert, TruNat etc.)
- Policy on monitoring is unclear and even if the policy were executed correctly to have sputum testing, we do not expect that it is going to bend the curve, primarily because the bacterial load would be lower.

Our Prediction

Human Annotation

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<th>F1-score</th>
<th>Precision</th>
<th>Recall</th>
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<td>91.04</td>
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<td>SENet</td>
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<td>Prior work</td>
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<td>83.78</td>
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Previous Technical Progress:
Potential new use-cases

1. X-Ray - **Automated chest X-ray reading for diagnosis and triaging.**

2. Anthropometry - **Using images for volume/weight estimation in adults.**

3. Adherence - **AI for identifying individuals likely to drop-out from treatment.**

4. Optimizing ACF - **Overlay multiple data sets to find patterns and identify hotspots (contributing to prevalence study + Nikshay v.2**

5. Ultrasonography - **AI-enabled US for screening, diagnosis and monitoring.**
Helping Cotton Farmers Achieve Sustainable Living

September 2018

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Cotton Farming

- Largest acreage in India after rice and wheat
- At the heart of farmer suicides and widespread protests by farmers. Pink bollworm destroyed 30% of last year’s crop
- Enormous government spending in subsidies, minimum support prices, loan waivers, and compensation for losses
- Partners: Maharashtra Dept of Agriculture, CDFI, Skymet
Cotton Farming Challenges and Opportunities

- Largest acreage in India, after Rice and Wheat.

**Use-cases**
- Acreage estimation
- Crop yield estimation
- Crop yield prediction
- Crop health assessment
- Harvest grading
- Disease prediction
- Crop planning advise

**Partners**
- Skymet
- Centre for Digital Financial Inclusion (CDFI)
- Maharashtra Department of Agriculture (MDA)

**Data:** Skymet is India’s largest weather data company with historical data including crop yields, and ability to collect variety of data (e.g., high-res imaging using drones). MDA has 11,000 field staff who can gather data.

**Piloting:** CDFI provides software system ‘Kanchi’ for Farmer Producer Companies / Orgs; Some national direct benefit transfer programs run on their systems. Skymet and MDA also have relationships and mechanisms to pilot through.

**Scaling:** MDA’s programs are vehicles for scaling. Specifically, it is keenly supporting growth of FPCs.

*Soybean is another crop where promising data exists.*
Cotton Farming: Initial Use Case

POTENTIAL AI-ENABLED SOLUTIONS

● Disease detection
● Disease prediction
● Crop grading & segregation (Assaying)
● Crop advisory
● Acreage estimation
● Yield estimation
● Yield prediction
● Pricing crop insurance
● Tools for field workers

INITIAL USE CASE

Disease detection

● The 2017 pink-bollworm outbreak that wiped out 1/3 of Maharashtra’s cotton crop went undetected by 11k extension workers. Can AI help?
● Plugs into existing behaviour: farmers already send crop pics over Whatsapp to agri experts
HUB
Wadhwani AI Hub

S-E-E-D

Engaging experts and communities to create solutions, data and tech platforms
The Hub: Activities

- Identify Problems and make available to others
- Aid collaboration between external partners
- Crowdsourcsource solutions

- Data ecosystem creation and availability
  - Sourcing, governance and management
  - Aid discovery of data sets
- Technology Platform availability

- Periodically publish curated list of relevant information
  - Blogs/white papers
  - Links to research, opinion pieces, etc
- Mentor/facilitate social entrepreneurs
- Facilitate faculty and scholar visits

- Summits / ConfEx, Talks & Webinars, Seminars
- Interviews, Podcast, Fireside chats
- Hackathons, Workshops & Symposia
- Open House/ Product Launches
- Newsletters
GLOBAL PRESENCE
Thought Leadership & PR/Outreach

- Key contributor to the NITI Aayog’s India AI strategy document
- Member of the MEITY committee on AI policy and strategy
- Invited speaker at the UN ITU AI for Social Good Summit
- Lead speaker at the Wilton Park Meeting on AI in Healthcare (UK)

Great inauguration coverage (see https://drive.google.com/open?id=1leWL2BqnQmlkl0-INM7aKvJvrAC3o8h8)
Continuing articles (e.g., http://www.forbesindia.com/article/ai-work/we-want-to-be-an-ai-hub-for-social-innovation-p-anandan/50665/1)

ICML BOOTH (see pics next page)
Thank You!

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https://www.wadhwaniai.org/