Leveraging Artificial Intelligence in the Era of COVID-19

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Faculty of Medicine Universitas Indonesia, November 2021
INTRODUCTION

Cause of Death: Cohort Research Data of Non-Communicable Diseases

1990:
1. Cardiovascular Disease
2. Cancer
3. Tuberculosis and Lung Infections Diseases
4. Pregnancy
5. Typhoid Fever
6. Non-Infectious Lung Disease
10. Chronic Kidney Disease

2019:
1. Cardiovascular Disease
2. Cancer
3. Non-Infectious Lung Disease
4. Tuberculosis and Lung Infections Diseases
5. Chronic Kidney Disease
6. Typhoid Fever
9. Pregnancy
10. Typhoid Fever

Current Research and Development for Screening

Source:
- https://radiopaedia.org/cases/lung-cancer-6?lang=gb

HOW TO OPTIMISE PATIENT SELECTION CRITERIA FOR BETTER OUTCOME AND TO IMPROVE QUALITY OF LIFE?

Source: Ministry of Health of The Republic of Indonesia at The 5th Open Innovation IMERI, 2021
Medical Imaging Diagnostics ; Clinical Pathology Diagnosis

Such assessment is often based on education and experience and can be, at times, subjective
AI in Respiratory Medicine

Computer vision for disease severity COPD

Computer vision for Lung Infection (TUBERCULOSIS)

Computer vision and molecular signatures for diagnosis of pulmonary fibrosis

Predictive models in pulmonary hypertension, asthma, pleural infections and pulmonary function tests

Computer vision for lung nodule detection and prediction risk for malignancy

AI in the SARS-CoV-2 pandemic

Courtesy IMERI, FKUI
Artificial Intelligence for COVID-19

The fast-track development of AI detection of COVID-19 on X-ray images
Problem:

- Nucleic acid detection took longer time (turn around time).
- If the patient is not diagnose in time → then the patient cannot be separated and classified in time.
- After the inpatients better, beds are occupied due to not able to examine in time.
- **Late period:** nucleic acid testing false negative problems due to specimen collection, preservation and transportation, processing, detection technology and reagent equipment.

Best Diagnostic Approach:

“Clinical + Imaging + Lab Testing”
AI for COVID-19

Methods: Retrospective study (validation) and Prospective study (diagnosis) in RSCM, RSUI & RSMH

Courtesy IMERI, FKUI

Yusuf PA, Tenda ED, Zulkarnaen B, Wulani V, Yunus RE, Pit, Sjahta F, Asaf MM,
The CAD4TB software starts with a quick inspection of a new X-ray image.

Methods: Retrospective study - analyzing up to thousands of x-ray TB patient data from RSCM

Yusuf PA, Tenda ED, Yunus RE, Pitoyo CW, Septiyanti W, Amal MY, Susanto AP, Chahyati D, Rahadianti L
Pendanaan HIBAH PUTI Kerjasama Internasional 2Q2 UI 2020
Digitalization of clinical data in the electronic health records (EHR) together with the road to value-based care, shifting reimbursement climate, lifetime cost of treating patients, unsustainability of hospital-based care in chronic disease management, and viability of remote patient monitoring makes the time right in the U.S. to utilize EHR data analytics and artificial intelligence (AI) approaches to identify high-risk, high-cost patients.

(REF: https://scholar.harvard.edu/pengli/digital-health)
“AI will not replace doctors, but instead will augment them, enabling physician to practice better medicine with greater accuracy and increased efficiency” … Benjamín Bell
AI in Era of COVID

UPMC COVID Outreach:
Pilot results & ongoing support
Addressing Healthcare clinical data accessibility

Realyze’s Technology automatically "explains" the sum of all structured and unstructured data, resulting in a more accurate and **complete picture of each patient**.

The solution enables you to:
- Prioritize patients to benefit from specialized care
- Intervene before high-cost events occur
- Optimize care and insurance offerings that better serve the patient

*We help you **Realyze** your patient and populations in greater detail*
Platform that expands with each clinical model

Artificial Intelligence

Clinical Expertise

Ontologies

Continually Enhancing the Patient Story

Enables Rapid development of new clinical models
**Why AI?**

Problem is **not a lack** of healthcare data – it’s the **accessibility** of data

<table>
<thead>
<tr>
<th>Incomplete Digitization</th>
<th>Disorganized Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Most patient data trapped in clinical notes</td>
<td>• Data is missing context – disconnected from the patient story</td>
</tr>
<tr>
<td>• Structuring more data causes provider burnout</td>
<td>• Data is episodic, not longitudinal</td>
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</tbody>
</table>

**Challenges**

COVID-19 necessitated a rapid-shift in how UPMC St. Margaret’s Family Health Center delivers care:

• Help high-risk patients while avoiding in-person office encounters
• Need for identification of high-risk patients based on demographics, conditions and social determinants
• Need to free up UPMC hospital resources to focus on COVID-19
• Current reporting limited with long turnaround times resulting in chart review to understand patient’s risk
The Problem

How healthcare manages populations today

Broad categories mapped to standard pathways in a transactional manner

Patients’ health care needs

Complex always evolving conditions that require specialized care coordination

1. Identify high-risk patients quickly (demographics, chronic conditions, social needs, utilization)
2. Prioritize & Outreach to maximize resources and impact
3. Intervene with education & alternative care delivery
4. Track and follow-up.

The patients’ complexities are locked in the unstructured notes
Realize Precision Cohorts – COVID Example

Combination of structured and unstructured data, “Realized” from within the chart to explain the current patient condition

Patient prioritization
Precise “live” cohorts

Resources

Referral to Specialist
Change Care
Prevent from ED
St. Margaret’s / Outreach Reports

Approach Taken

- Designed and delivered practice-specific risk reports (*in 1 week*)
  - Utilized current hcOS (current UPMC document management system) infrastructure for access to patient chart data
  - Started with any patient with an office visit in the past 3 years
  - Prioritized report by various risk factors both in structured data and unstructured data extracted from notes (Example: Over 65 years old and mention of living alone in their notes)
  - Generated excel report as light weight workflow to overlay on EMR
  - Iterated with SMFHC team 3x week to align report with the workflow and operational model

Solution Overview

- Gathered all patients that visited the practice within the past 3 years
- Identified risk factors across utilization, clinical, and social domains, including using clinical notes
  - Utilization: ED visits, admissions, recent discharges
  - Clinical: Chronic conditions, O2 therapy, inhaler use
  - Social: Lives alone, food insecurity
- SMFHC residents dynamically filter and prioritize patients to perform outreach
## Population and Risk Factors

| PatientID | Date of Birth | Sex | Last Outcomes | PCP | Last Note of Review | Not a priority | Last high risk | Outreach List | Last outreach | Able to see | Outreach by | Next out | Comments |
|-----------|--------------|-----|---------------|----|--------------------|---------------|---------------|--------------|---------------|-------------|-------------|-----------|----------|----------|
| 1         | 1/1/2020     | M   | TRUE          | TRUE | FALSE              | FALSE         | FALSE         | FALSE        | FALSE         | FALSE       | FALSE       | TRUE      |
| 2         | 1/2/2020     | F   | TRUE          | TRUE | FALSE              | FALSE         | FALSE         | FALSE        | FALSE         | FALSE       | FALSE       | TRUE      |
| 3         | 1/3/2020     | M   | TRUE          | TRUE | FALSE              | FALSE         | FALSE         | FALSE        | FALSE         | FALSE       | FALSE       | TRUE      |
| 4         | 1/4/2020     | F   | TRUE          | TRUE | FALSE              | FALSE         | FALSE         | FALSE        | FALSE         | FALSE       | FALSE       | TRUE      |
| 5         | 1/5/2020     | M   | TRUE          | TRUE | FALSE              | FALSE         | FALSE         | FALSE        | FALSE         | FALSE       | FALSE       | TRUE      |
| 6         | 1/6/2020     | F   | TRUE          | TRUE | FALSE              | FALSE         | FALSE         | FALSE        | FALSE         | FALSE       | FALSE       | TRUE      |
| 7         | 1/7/2020     | M   | TRUE          | TRUE | FALSE              | FALSE         | FALSE         | FALSE        | FALSE         | FALSE       | FALSE       | TRUE      |
| 8         | 1/8/2020     | F   | TRUE          | TRUE | FALSE              | FALSE         | FALSE         | FALSE        | FALSE         | FALSE       | FALSE       | TRUE      |
| 9         | 1/9/2020     | M   | TRUE          | TRUE | FALSE              | FALSE         | FALSE         | FALSE        | FALSE         | FALSE       | FALSE       | TRUE      |
| 10        | 1/10/2020    | F   | TRUE          | TRUE | FALSE              | FALSE         | FALSE         | FALSE        | FALSE         | FALSE       | FALSE       | TRUE      |

*Note: The table continues with similar entries.*
## Risk factors

| A1 | LastVisit | NextAppt | Cancelled Appt | ECMO | ECMO_19_or_20 | ADAM_19_or_20 | Discharge-30D | Chronic Condition | Hypertension | Diabetes | Malignant Dm | CTD | Therapy | Alcohol | Smoking | Assault | Abuse | Unemployment | Youth_Services | LastDay |
|----|-----------|----------|----------------|------|---------------|---------------|---------------|----------------|--------------|-----------|------------|------|---------|---------|---------|---------|--------|-----------|--------|----------|----------|--------|
| 26 | 4/27/20   | 7/6/20   | FALSE          | 6    | 0             | 0             | 0             | FALSE          | FALSE        | FALSE     | FALSE      | FALSE | FALSE   | FALSE   | FALSE   | FALSE   | FALSE   | TRUE      | FALSE  | TRUE     | FALSE   | FALSE   |
| 48 | 1/18/19   |          | FALSE          | 0    | 0             | 0             | 0             | FALSE          | TRUE         | FALSE     | FALSE      | FALSE | FALSE   | FALSE   | FALSE   | FALSE   | FALSE   | FALSE     | FALSE  | FALSE    | FALSE   | FALSE   |
| 59 | 3/6/20    | 5/8/20   | FALSE          | 0    | 0             | 0             | 0             | FALSE          | TRUE         | FALSE     | FALSE      | FALSE | FALSE   | FALSE   | FALSE   | FALSE   | FALSE   | FALSE     | FALSE  | FALSE    | FALSE   | FALSE   |
| 28 | 2/20/20   | 5/7/20   | FALSE          | 1    | 0             | 0             | 0             | FALSE          | TRUE         | FALSE     | FALSE      | FALSE | FALSE   | FALSE   | FALSE   | FALSE   | FALSE   | FALSE     | FALSE  | FALSE    | FALSE   | FALSE   |
| 20 | 11/19/17 |            | FALSE          | 1    | 0             | 0             | 0             | FALSE          | FALSE        | FALSE     | FALSE      | FALSE | FALSE   | FALSE   | FALSE   | FALSE   | FALSE   | TRUE      | FALSE  | FALSE    | FALSE   | FALSE   |
| 30 | 1/13/20   |          | FALSE          | 0    | 0             | 0             | 0             | FALSE          | FALSE        | FALSE     | FALSE      | FALSE | FALSE   | FALSE   | FALSE   | FALSE   | FALSE   | FALSE     | FALSE  | FALSE    | FALSE   | FALSE   |
| 37 | 7/11/19   |          | FALSE          | 1    | 0             | 0             | 0             | FALSE          | TRUE         | FALSE     | FALSE      | FALSE | FALSE   | FALSE   | FALSE   | FALSE   | FALSE   | FALSE     | FALSE  | FALSE    | FALSE   | FALSE   |
| 44 | 10/23/19  |          | FALSE          | 0    | 0             | 0             | 0             | FALSE          | TRUE         | FALSE     | FALSE      | FALSE | FALSE   | FALSE   | FALSE   | FALSE   | FALSE   | FALSE     | FALSE  | FALSE    | FALSE   | FALSE   |
| 25 | 10/31/19  |          | FALSE          | 2    | 0             | 0             | 0             | FALSE          | FALSE        | FALSE     | FALSE      | FALSE | FALSE   | FALSE   | FALSE   | FALSE   | FALSE   | FALSE     | FALSE  | FALSE    | FALSE   | FALSE   |
| 62 | 1/11/20   |          | FALSE          | 0    | 0             | 0             | 0             | FALSE          | TRUE         | TRUE      | TRUE       | TRUE  | TRUE    | TRUE    | TRUE    | TRUE    | TRUE    | TRUE      | TRUE   | TRUE     | TRUE    | TRUE    |
| 34 | 4/4/18    |          | FALSE          | 0    | 0             | 0             | 0             | FALSE          | FALSE        | FALSE     | FALSE      | FALSE | FALSE   | FALSE   | FALSE   | FALSE   | FALSE   | FALSE     | FALSE  | FALSE    | FALSE   | FALSE   |
| 28 | 8/13/19   |          | FALSE          | 0    | 0             | 0             | 0             | FALSE          | TRUE         | TRUE      | TRUE       | TRUE  | TRUE    | TRUE    | TRUE    | TRUE    | TRUE    | TRUE      | TRUE   | TRUE     | TRUE    | TRUE    |
| 62 | 3/2/20    |          | FALSE          | 2    | 0             | 0             | 0             | FALSE          | TRUE         | TRUE      | TRUE       | TRUE  | TRUE    | TRUE    | TRUE    | TRUE    | TRUE    | TRUE      | TRUE   | TRUE     | TRUE    | TRUE    |
| 81 | 12/20     |          | FALSE          | 1    | 0             | 0             | 0             | FALSE          | TRUE         | FALSE     | FALSE      | TRUE  | FALSE   | TRUE    | TRUE    | TRUE    | TRUE    | TRUE      | TRUE   | TRUE     | TRUE    | TRUE    |
| 33 | 2/4/20    |          | TRUE           | 0    | 0             | 0             | 0             | FALSE          | FALSE        | TRUE       | TRUE       | TRUE  | TRUE    | TRUE    | TRUE    | TRUE    | TRUE    | TRUE      | TRUE   | TRUE     | TRUE    | TRUE    |
| 41 | 3/8/18    |          | FALSE          | 0    | 0             | 0             | 0             | FALSE          | TRUE         | FALSE     | FALSE      | FALSE | FALSE   | TRUE    | TRUE    | TRUE    | TRUE    | TRUE      | TRUE   | TRUE     | TRUE    | TRUE    |
| 60 | 4/17/18   |          | FALSE          | 0    | 0             | 0             | 0             | FALSE          | TRUE         | FALSE     | FALSE      | TRUE  | FALSE   | TRUE    | TRUE    | TRUE    | TRUE    | TRUE      | TRUE   | TRUE     | TRUE    | TRUE    |
| 66 | 9/15/17   |          | FALSE          | 0    | 0             | 0             | 0             | FALSE          | TRUE         | FALSE     | FALSE      | TRUE  | FALSE   | TRUE    | TRUE    | TRUE    | TRUE    | TRUE      | TRUE   | TRUE     | TRUE    | TRUE    |
| 20 | 11/9/17   |          | TRUE           | 0    | 0             | 0             | 0             | FALSE          | FALSE        | TRUE       | TRUE       | TRUE  | TRUE    | TRUE    | TRUE    | TRUE    | TRUE    | TRUE      | TRUE   | TRUE     | TRUE    | TRUE    |
3 SMFHC Practices – 4 weeks (3/29 – 4/26)

All Patients: 12,360

- Identified for Review: 1,454 / 100%
  - Reviewed Only: 425
- Attempted Outreach: 1,029 / 71%
  - Left Message: 163
  - Unable to reach: 63
  - Sent MyUPMC: 65
  - Sent Letter: 28
  - No follow-up planned: 227
- Phone contact: 733 / 50%
- Intervention / Follow-up: 506 / 35%
  - Medication Refilled/Adjusted: 52
  - Social Work Referral: 21
  - Escalated to telehealth: 19
  - Unspecified follow-up: 414
### Pilot results – March 29 to April 26

<table>
<thead>
<tr>
<th></th>
<th>Without report</th>
<th>With report</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 RFP practices</td>
<td></td>
<td>3 SMFHC practices</td>
</tr>
<tr>
<td>Replacement of office visits with telemedicine visits</td>
<td>45%</td>
<td>46%</td>
</tr>
<tr>
<td>Increase in phone calls (outbound and inbound)</td>
<td>114%</td>
<td>143%</td>
</tr>
<tr>
<td>Percent of patients with calls &amp; telemedicine</td>
<td>52%</td>
<td>72%</td>
</tr>
<tr>
<td>Average number of risk factors for telemedicine patient</td>
<td>1.41</td>
<td>2.16</td>
</tr>
<tr>
<td>Repeat telemedicine encounters</td>
<td>8%</td>
<td>30%</td>
</tr>
<tr>
<td>Avg number of risk factors for repeat telemedicine pts</td>
<td>1.88</td>
<td>2.54</td>
</tr>
</tbody>
</table>

**Anecdotes**

- Avoided ED utilization for geriatric fall patient – reviewed and triaged remotely
- Prevented event for actively suicidal patient – connected with behavioral health
- ...many more

**With report**

- Similar telemedicine rates
- Increase in calls leading to telemedicine
- Engagement with higher risk patients and more repeat engagement
Delivering with Clinical and Technical Expertise

- Explains patients by combining structured data, semi structured data, and unstructured free form text
- Interfaces with over 30 different EMR / document sources
- Standards based – FHIR, SNOMED, LOINC and RxNorm
- Validated preconfigured clinical models with ability to extend
- AWS HIPAA complaint hosted solution (or deployed into third party cloud environments)
- ML and NLU built in or support for existing ML/NLU models
- Clinical tools for validation and extension to accommodate documentation variations and unique clinical concepts
- Support with both clinical and technical professional services

*We expand on where EMRs and EDWs stop*
How Realyze Helps

**Care**
- Summarizes clinical details about the patient in near real time to provide within existing workflows
- Identify patient’s care needs proactively to reduce disease progression and readmissions

**Analytics / Research**
- Provide patient prioritization used in conjunction with existing structured data
- Find patients for research and clinical trial matching

**Pop Health**
- Create precision patient cohorts
- Manage patients in risk-based programs at a more detailed level of clinical knowledge

**Quality**
- Auto Abstract quality details and items for registry entry
- Reduction in manual abstraction costs and quicker turnaround time on data

**Revenue Cycle**
- Optimize for CAC and other vendors to accelerate auto coding and CDI
- Reduction in manual labor and increase in reimbursement accuracy
Explaining the **patient** beyond what can be done with the EMR and structured data

- Clinical focus – Machine Learning with clinical knowledge influence
- Patient level understanding with real-time and always up to date data
- Longitudinal to reflect how a patient condition evolves
- Scalable and flexible to meet complex healthcare data challenges
Healthcare AI in Singapore

A/Prof Ngiam Kee Yuan
MBBS (Lond), MRCS (Glasg), Mmed (Surg), FRCS (Edin)
Senior Consultant and Group Chief Technology Officer
Division of Thyroid and Endocrine Surgery
Department of Surgery
Deputy Chief Medical Information Officer
National University Hospital Singapore
Outline

• Landscape of Healthcare in Singapore

• AI use cases in COVID
Landscape of Healthcare in Singapore
Singapore Healthcare Facts and Figures

96,000 PEOPLE
Nurses, Doctors, Administrative staff, Allied health professionals (AHPs), Ancillary staff, Support care staff, Pharmacists, Dentists

PRIMARY CARE
2,991
Polyclinics, GP and dental clinics

ACUTE CARE
26
Public and private hospitals

COMMUNITY CARE
189
Community hospitals, nursing homes, day care centres, home care providers
Long Term Trends and Challenges

- Ageing population
- Increasing chronic disease burden
- Slower workforce growth
- Rising healthcare costs

Source: https://www.opengovasia.com
Healthy Living Master Plan

Move beyond Hospital to Community
To enable Singaporeans to receive appropriate care in the community and closer to home

Move beyond Quality to Value
To give every Singaporean best value, while keeping our system sustainable

Move beyond Healthcare to Health
To help and support Singaporeans to lead healthier lives

The Triple Aim in Healthcare
Smart Nation is our next-gen nation-building effort

“Smart Nation is about Singapore taking full advantage of IT. Using IT comprehensively to create new jobs, new business opportunities, to make our economy more productive, to make our lives more convenient. To make Singapore an outstanding city in which to live, work and play.” Aug 2017

Launched Digital Readiness Blueprint to help every last man cross the digital divide (2018)
At the 32nd ASEAN Summit on 28 April 2018, the ASEAN Leaders established the ASEAN Smart Cities Network (ASCN). The ASCN is a collaborative platform where cities from the ten ASEAN Member States (AMS) work towards the common goal of smart and sustainable urban development.
National Smart Health Initiatives

**Going Digital**
- HealthHub
- National Electronic Health Records

**Tele Health**
- Elderly monitoring systems
- Video consultations Tele rehabilitation
- Vital signs monitoring

**Health Marketplace**
- Match-A-Nurse Services and supplies

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**Smart Ward and Smart Logistics**
- Hospital of the Future

**Hospital Operations Centre**
- Dashboards
- Graphical interface
- Video analytics

**Robots**
- Robotic Middleware Framework
- Autonomous mobile robots
- Assistive robots

**Artificial Intelligence**
- Image diagnostics
- Chatbots
HealthHub

• One-stop portal and mobile app for Singaporeans

• To access a wide range of health content, rewards and e-services

• Designed to empower Singaporeans to take greater ownership of their health and wellness

https://www.healthhub.sg/a-z/health-statistics/12/health-manpower
This vision can be enabled with digital solutions that create a seamless experience for patients and staff while enhancing quality of care

1. Appt booking
   Easily identify which clinic to go to from chatbot or be directed to book appointments date/time online

2. Registration
   Registers online without having to arrive earlier
   Be updated on waiting time and queue status, real time

3. Payment
   View bill through the app and decide to settle online
   Ability to settle all bills in one sitting

4. Education materials
   Directed to chatbot for basic medical queries and receive personalized education materials

5. Self-monitoring
   Records glucose levels in app and gets rewarded with health credits
Close-up view of digital initiatives

Appointment Slot Suggestion
Online Registration
Digital Payment
Chatbot Medical Query
Health Credits
AI use cases in COVID
OneNUHS App

&

OneNUHS Health Chatbot
Telemedicine

1. Develop the Guideline and SOP according to health landscape in Singapore
2. Collecting feedback from partitioner and patient
3. Government agency work with industry player closely

Take Charge Of Your Health With Doctor Anywhere
Access a full suite of health and wellness services to look after every aspect of your healthcare needs.

- DA Virtual Clinic
- DA Clinic
- DA Home Care Services
- Chronic Disease Management Program
- DA Marketplace
- DA Mental Wellness
Fight Covid-19 Together 合力追踪器

With the TraceTogether Token, you can keep yourself and your loved ones safe from COVID-19!

Always bring your token with you when you go out.

Check that the green light is blinking.

Email or call the hotline if your token is faulty, or misplaced.

Don't cover up the QR code on the token.

Don't drop or tamper with the token.

Don't put the token near heat or into water.

Please cooperate with our authorised officers should your token be requested for contact tracing purposes.

Let’s TraceTogether for a Safer Singapore!

support@tracetogether.gov.sg  Hotline: 6973 6511
Healthcare is a significant cornerstone of every political system in the world. This is even more so in the post-pandemic world, where tectonic shifts in the way medicine is transacted have altered the dynamics between healthcare providers and patients.

The pandemic has exposed opportunities for the quality of healthcare delivery to be improved dramatically, propelled by digital innovations such as artificial intelligence (AI) and automation, and the acceptance of new modes of healthcare delivery.

Due to movement and travel restrictions during the pandemic, telemedicine has become the primary means through which people gain access to outpatient healthcare services. With the increasing penetration of smartphones to rural communities, isolated communities now have more teleconsultation services made available to them. This is only possible because of the increased demand for chronic care, which is crucial to prevent the onset of chronic diseases, which is a major burden in both developing and developed countries. The same strategy is also employed to help patients who have been discharged from the hospital to manage their health at home, in the hope of bringing healthcare from the hospital to the community.

Given the accessibility to these digital applications, there are now as many as 325,000 health-related apps in the various app stores. This presents a dilemma to the consumer, as the reliability and ease of use of these apps are highly variable. Furthermore, these apps are not typically integrated with public healthcare systems, leading to limitations in the accuracy of data and the effectiveness of interventions.

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Thank you for your attention!

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Thank you.
Data Innovations and the COVID-19 response

Lessons from Indonesia

Paul Pronyk, Deputy Director, SDGHI

University of Indonesia: Iwan Ariawan, Pandu Riono, Muhamad N Farid, Hafizah Jusril
UNICEF: Charlotte Lie-Piang, Suci Wulandari, Anthony Mockler, Bheta Arsyad, Fernando Carrera, Benjamin Grubb, Manual Herranz, Vedran Sekara
Asian success in COVID control?

Source: Worldometer, May 23, 2021
SE Asia: Highest COVID-19 seroprevalence in the world

Modelled seroprevalence globally by WHO region
Seroprevalence has increased globally though at different rates across WHO regions.

Source: https://serotracker.com/en/Analyze
Elimination vs Suppression

COVID-19: 80+% of infections → few or no symptoms

**Well-resourced health system**
- Precision public health approaches
  - Screening
  - Early detection and isolation
  - Contact tracing

**Poorly-resourced health system**
- Test the sickest
- Widespread community transmission
- Population based strategies essential

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**Sources:**
- China CDC Weekly. The Epidemiological Characteristics of an Outbreak of 2019 Novel Coronavirus Diseases (COVID-19), Feb 2020
- Li R, et al. Substantial undocumented infection facilitates the rapid dissemination of novel coronavirus (SARS-CoV2), Science, March 16, 2020
Circuit breakers and adaptive triggering

<table>
<thead>
<tr>
<th></th>
<th>DAY 0-14</th>
<th>DAY 7-21</th>
<th>DAY 21-30</th>
<th>DAY 30+</th>
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<tbody>
<tr>
<td><strong>Transmission</strong></td>
<td>Behavioural monitoring absent</td>
<td>Low testing</td>
<td>Poor hospital records</td>
<td>Death reporting systems poorly developed</td>
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<tr>
<td><strong>Cases</strong></td>
<td></td>
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<td>No national database</td>
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<tr>
<td><strong>Hospitalization</strong></td>
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<td>Delayed reporting</td>
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<tr>
<td><strong>Deaths</strong></td>
<td></td>
<td></td>
<td>COVID vs concurrent disease</td>
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</tr>
</tbody>
</table>

**LMIC Gaps**

- Digital innovations

**Source:** Ferguson, N., D. Laydon, et al. (2020). Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand. London, Imperial College.
Can digital innovations inform policy decisions?

Greater Jakarta
25 million population
Big-data and physical distancing

Big Data
- Google/Cuebiq – Android phone
- Facebook – 140 million users in Indonesia
- Anonymized/aggregated, updated daily
- Visualize down to village level
- Accurate to 50m
- **Stay-at-home** = day location vs night location
- Movement between areas

Policy introduction
- Link to timing of policy changes

COVID-19 cases
- Individual case data from Jakarta government
- Adjusted for date of symptom-onset
Policy, mobility and COVID-19 - JAKARTA

- Immediate effects of policy change
- Predictive of COVID-19:
  - 7 days advance warning
- Immunity?
  - Oct vs April
  - Lower ‘stay-at-home’ needed to reduce transmission

Sources: Cuebiq mobility, Governor of Jakarta daily cases
What level of mobility reduction is enough?

New Daily Cases

% Stay at home

55-65% stable

50-55%: each 1% increase → 20 more cases/day

<50%: each 1% increase 100 more cases/day
AI and remote sensing: Wealth gradients

Source: % population stay at home based on Cuebiq mobility data.
Proportion who ‘stay-at-home’ by local area

Source: Cuebiq data
Better targeting of social protection programs

**SUPPORT TO VILLAGES FOR COVID-19**
- Guidance on the use of Village Fund For local COVID-19 Response
- Increased local funding to enhance enrolment into social protection schemes (11 million new beneficiaries)

**EXPANDED SOCIAL PROTECTION FOR HOUSEHOLDS**
- Kartu Sembako Murah Staple food purchase
- Program Keluarga Harapan Cash Grants
- Kartu Pra-Kerja Small Business Informal Workers
- Expanded from 15 to 20 million recipients
- Increased benefit package by 25% per month to poor households (10 million beneficiaries)
- Increased enrollment by 11 million households
Real-time behaviour monitoring

✓ Observed behavior
  - Independent volunteers
  - Two reported observations per day
  - 10 people per observation

✓ Focus on public places
  - School, religious place, station, public transport, markets

✓ Mobile phone data collection
  - Sms, Whatsapp

✓ Data visualization

✓ Immediate user-feedback
Population-based approaches to COVID suppression

**Big-data**
**Real-time monitoring**
- Monitor behaviours that influence transmission

**AI & remote sensing**
- Identify vulnerable communities

- Overcome gaps in testing, surveillance and reporting capacity
- Allows more tailored population-based risk reduction
- Enables local action
- Targeted social protection programs

When precision public health measures are not an option