Managing the Global COVID-19 Pandemic with Health Informatics

Successes and Challenges

April 7, 2020
This webinar series is designed to share informatics responses and discuss informatics challenges to the COVID-19 pandemic

• The series will highlight how the informatics community is addressing this global pandemic from all angles
• Panelists will share their informatics experience in specific domains, including the challenges and solutions that they have developed and implemented within their institutions.
• Several additional webinars are being planned to highlight members of AMIA and the wider informatics community
• Visit AMIA.org/COVID19
Panelists (in order of appearance)

- **Theresa Cullen**, MD, MS, FAMIA, Associate Director, Global Health Informatics, Regenstrief Institute & Associate Professor of Clinical Family Medicine Indiana University School of Medicine
- **Hamish Fraser**, MBChb, MSc, FACMI, Associate Professor of Medical Science, Brown Center for Biomedical Informatics, Brown University
- **Carl Leitner**, PhD, Technical Director, Digital Square
- **Hong Zhu**, MD, Chairman and Professor in Public Health, Nanfang Hospital Southern Medical University
- **Gong Mengchun**, MD, Senior Vice President and Chief Medical Informatics Officer, DCHealth Technologies
- **Tuan Ngo**, Health Information System (HIS) Team Lead PATH's Vietnam Country Office
Agenda

• Brief introduction to AMIA’s Webinar Series, Global Health Informatics and the Role of Digital Square
• The Honghu Strategy for COVID-19 Surveillance and Management
• Using big data for effective surveillance and control of COVID19: Useful experiences from Hubei province of China
• Using data and data visualization during the COVID 19 response in Vietnam
AMIA’s GHI-WG

The mission of the **Global Health Informatics Working Group** is sharing of informatics best practices in resource-constrained countries.

Specifically, the GHI-WG fosters the dissemination of global health informatics practices and principles, provides opportunities to increase capacity in informatics, facilitates collaboration in investigations of emerging technologies and disruptive innovations, advocates for the effective evaluation of informatics interventions, and supports a forum for exchange of experiences and expertise.

The GHI-WG is also a forum for exchange of best health informatics ideas, practices and code world-wide.
Health Informatics is the science of how to use data, information, and knowledge to improve human health, including the execution of scientific research, the delivery of health care services, and the promotion of public health. AMIA is the multi-disciplinary, inter-professional home for 5,400+ health informatics experts.

Digital Square is a partnership of the world’s leading digital health experts from 40+ organizations and countries working together to strengthen digital health systems in emerging economies. We support co-investment into scalable technology solutions and create the environments in which they can be sustained. Digital Square is led by and housed at PATH, the leader in global health innovation.
Purpose and Goals

- Identifying and collating information relating to data standards and exchange relevant to the COVID-19 response
- Identifying gaps in and establishing standards for data exchange priorities
- Provide documentation and guidance (to both the global good community as well as proprietary software tools) to improve adherence to these standards
- Ensure that rapidly deployed solutions can be integrated into the national digital health architectures
Hong Zhu, MD
Chairman and Professor in Public Health
Nanfang Hospital Southern Medical University

gmc@nrdrs.org
The Honghu Strategy for COVID-19 Surveillance and Management
the Honghu Strategy
for COVID-19 Surveillance and Management

Zhu Hong, Ph.D.
Chairman, Nanfang Hospital
Professor in Public Health, Southern Medical University
CONTENT

1. Honghu, the city of Lotus
2. How was the COVID-19 like when we arrived in Honghu?
3. the Honghu Strategy: 4 Pillars
4. the Success of Battle against COVID-19 in Honghu
5. Lessons learnt
6. Conclusion
Honghu, the city of Lotus

- Honghu in Hubei Province
- Geographically very close to Wuhan
- Population of over 900,000 people
- Well-known for the beautiful lake and the lotus
What was it like when we arrived in Honghu?

Pros
- **55,000** Residents with Wuhan travel history
- **263** Confirmed and suspected cases

Cons
- **0** nucleic acid testing platform
- **0** ICU for COVID-19
- **0** Positive Pressure PPD for Intubation
- **0** In-hospital infection control experts for COVID-19
- Overwhelmed doctors and nurses
Honghu Model: Four Pillars

1. Direction by Experts
   - Testing platform
   - Community screening
   - Health information system
   - Clinical information sharing

2. Coordination by Government

3. Involvement of Residents
   - ‘Five Zones’
   - Experts consultation
   - Module hospital
   - Medical resource

4. Support by Informatics
Health status declaration platform
Syndromic Surveillance Residents in Honghu

Honghu Health Reports Heat Map

Number of applicants
- <15000
- 15001 - 30000
- 30001 - 50000
- >50000

Close contacts
- <50
- 51 - 100
- 101 - 200
- 201 - 400
- >400

Miles
Five-zone Strategy for COVID-19 Management

Patients

Nucleic acid test  Blood biochemical test  Imaging test

Clinical classification

Severe and critical  High-risk warning  Non-severe  Suspected  Rehabilitation observation

Patients management

Diagnosed critical severe pneumonia and suspected  MuLBSTA score more than 12  Diagnosed normal and mild pneumonia  Suspected with mild symptoms  Condition improved and discharge standards reached
The Success of Battle against COVID-19 in Honghu

- Total diagnosed
- Total discharged or transferred
- Patients remained
- Daily diagnosed
- Daily discharged or transferred

Arrival of the Medical Aid Team

Number of patients

0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400

Lessons learnt

1. Coordination at the national scale was the most important step.

2. Taking care of the patients only was never enough. We had to take care of the city.

3. Protecting the healthcare professional at the frontline is always the first rule to follow.

4. Technologies played an essential role and most of the barriers can be overcome.

5. The willingness of the residents to contribute should never be underestimated. The people were the true origin of power to defeat the disease.
Acknowledgement
Thank you.

Zhu Hong, zhnfyy@yeah.net
Gong Mengchun, MD
Senior Vice President and Chief Medical Informatics Officer
DCHealth Technologies

Member-at-Large
AMIA Global Health Informatics WG

gmc@nrdrs.org
Using big data for effective surveillance and control of COVID19: Useful experiences from Hubei province of China
Using Big Data for COVID-19 Control: Experiences from Hubei, China

Gong Mengchun, M.D.
SVP/CMIO, DCHealth Technologies
Member-at-Large, AMIA Global Health Informatics WG
Management Board Director, SNOMED International
1. Why did we need big data for the COVID-19 Control?
2. How did we build up the hybrid system?
3. How did the system work in real-world?
4. Migration of the system
5. Conclusion
Limitations of the Traditional Systems

- Poor Timeliness
- Low Spatial Resolution
- Weak Scalability
- Insufficient support to social distancing
- Disconnected with clinical data
Healthcare Big Data for Infectious Diseases Surveillance

Figure 1. Overview of the characteristics of infectious disease surveillance systems. Hybrid systems combining traditional surveillance with big data streams fall in the desirable zone associated with high information return and high data volume.

Simonsen et al, JID 2016:214 (Suppl 4)
1. Why did we need big data for the COVID-19 Control?
2. How did we build up the hybrid system?
3. How did the system work in real-world?
4. Iteration, Evaluation and Replication of the system
5. Conclusion
Honghu Hybrid System (HHS) for COVID-19

1. Integration of multiple platforms
2. Full-chain monitoring
3. High coverage
4. Connected with public health countermeasures

submitted to JMIR, under review
Why Cloud service?

- Travel control
- Lack of provider locally
- Coordination and remote support
- Interoperability across multiple platforms
- Scalability
- Functionality
Data Collection

- EMR data from 9 hospitals
  - Existing HIT systems (5)
  - Manual upload (4)
  - Daily

- Symptoms and Contact History Report
  - Wechat SDK (a mini program)
  - Real-time

- Diagnostic information
  - Manual
  - Daily

- One-on-One Engineer Remote Support
Phenotyping of the EMR Data

Original Data

Preprocessing

Structured?

Deletion of invalid data

OMOP

OMOP model

自然语言处理

NLP

编码规范化

Chinese Clinical Ontology

数据映射

Data Mapping

合并数据

Data Integration

Product-level Database

数据库
Data processing

a common data model for COVID-19
- Clinical doctors
- Researchers
- Public health professionals
- Informaticians

Vocabulary control
- SNOMED CT synonyms in Chinese for symptoms
- LOINC codes
- ICD

Data Analytics and Visualization
- Automatic
- Manual

submitted to JMIR, under review
Ethics review, Privacy protection and Data security

Nanfang Hospital Ethics Committee approved this study.

All the users on the syndromic surveillance system consented sharing the necessary information for using this system.

Written informed consent was obtained from the in-hospital patients.

All authorized personnel received training on data security and privacy protection and additionally, signed legally binding affidavits.

Independent data security auditor with adequate authority

Separation of sensitive data from the rest of the data
1. Why did we need big data for the COVID-19 Control?
2. How did we build up the hybrid system?
3. How did the system work in real-world?
4. Iteration, Evaluation and Replication of the system
5. Conclusion
72 hours to build HHS

• 17.5 million reports
• Maximum Daily Activities >750,000

- Leader board and policies developed (2/15 08:00)
- Organizational settings and personnel in place (2/15 18:00)
- Data export training completed (2/15 16:00)
- Data export begins (2/15 18:00)
- Hardware deployed (2/16 02:00)
- Essential software deployed (2/16 04:00)
- WeChat platform developed (2/16 11:00)
- WeChat internal testing begins (2/16 13:00)
- Security settings in place (2/16 16:00)
- First batch data upload begins (2/17 09:30)
- First batch data upload completed (2/17 13:00)
- WeChat internal test completed; public test started (2/17 16:00)
- Data verification, integration and analysis processes pass acceptance (2/18 03:00)

2/15 08:00 - 2/16 00:00
- EMR data import (2/16 06:00)
- EMR data integration (2/16 12:00)
- PCR test integration (2/16 22:00)

2/16 00:00 - 2/17 00:00

2/17 00:00 - 2/18 08:00
- Antibody lab data import (2/17 11:00)
- Public health data import (2/16 16:00)
Syndromic surveillance on mobile devices

- **Target Groups**
  - the general population
  - in-hospital and discharged patients
  - People with higher risk of infection
    - those with travel history to Wuhan
    - contact history with confirmed cases
    - under medical observation in isolation sites
  - Healthcare professionals
  - Social workers followed up over 10,000 positive reports (i.e. “I had a temperature of over 37.3°C” or “I had severe cough today”) via phone call or home visits.
  - More than 30 individuals were assisted in going to the fever clinic for further screening and then quarantined.

Real-time questionnaire on WeChat

| **Demographic characteristics** |  
| Name  
| ID Number  
| Gender  
| Address  
| Phone number |
| **Spatial information** |  
| Current location (from mobile device) |
| **Epidemiological exposure** |  
| Have you visited or stayed in communities with confirmed cases in last 14 days?  
| Have you been in contacted with confirmed cases in last 14 days?  
| Have you been in contact with patients from Wuhan City or from the community with case reports or have respiratory symptoms in the last 14 days?  
| Have you participated in small-scale gatherings with more than 2 cases reported in last 14 days? |
| **Symptoms and Signs** |  
| Today's physical condition: good / cough / runny nose / chest tightness / diarrhea / muscle soreness?  
| Today's temperature? |
| **Psychological conditions** |  
| Do you feel nervous, or fear, or anxious? |
| **Community support** |  
| Is there public health official to visit you for investigation?  
| Is there community worker come to you for solving your difficulties? |
| **Career support** |  
| Are you willing to work locally?  
| Are you willing to participate in free skill-trainings? |

submitted to JMIR, under review
HHS Coverage

Direction by Experts

Coordination by Government

Involvement of Residents

Support by Informatics

Daily Reports on Wechat Platform
"I had a temperature of over 37.3°C" or "I had severe cough today"
Data-driven Policy-making

Honghu Health Reports Heat Map

Reports of residents
- <15000
- 15001 - 50000
- 30001 - 50000
- >50000

Exposed residents
- <50
- 51 - 100
- 101 - 200
- 201 - 400
- >400

submitted to JMIR, under review
## Risk Prediction and Triaging

### Marker Score

<table>
<thead>
<tr>
<th>Marker</th>
<th>Score</th>
<th>OR</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multilobe Infiltrate</td>
<td>5</td>
<td>5.2</td>
<td>PACS, EMR</td>
</tr>
<tr>
<td>Low Lymphocytes</td>
<td>4</td>
<td>4.5</td>
<td>LIS</td>
</tr>
<tr>
<td>Bacterial Infection</td>
<td>3</td>
<td>3.7</td>
<td>LIS, EMR</td>
</tr>
<tr>
<td>Acute-smoker</td>
<td>3</td>
<td>3.2</td>
<td>EMR</td>
</tr>
<tr>
<td>Quit-smoker</td>
<td>2</td>
<td>2.2</td>
<td>EMR</td>
</tr>
<tr>
<td>Hypertension</td>
<td>2</td>
<td>2.4</td>
<td>EMR</td>
</tr>
<tr>
<td>Age ≥60</td>
<td>2</td>
<td>2.1</td>
<td>HIS</td>
</tr>
</tbody>
</table>

**MuLBSTA Score ≥ 13 → increased in-hospital mortality**

---

**THE LANCET**

Lancet 2020; 395: 507–13
1. Why did we need big data for the COVID-19 Control?
2. How did we build up the hybrid system?
3. How did the system work in real-world?
4. Iteration, Evaluation and Replication of the system
5. Conclusion
the enhancement of full spectrum of management of COVID-19

- Deployment of the syndromic surveillance platform,
  - High coverage
  - Mobile device
  - Empower the implementation of PHCM
- In-hospital mortality prediction system
  - Direct the clinical interventions of patients
  - Allocate the limited resources
- Seamless coverage of patients at different stages,
  - Healthy
  - Exposed
  - Isolation under medical observation
  - Admitted
  - Critically ill
  - Discharged
1. Why did we need big data for the COVID-19 Control?
2. How did we build up the hybrid system?
3. How did the system work in real-world?
4. Iteration, Evaluation and Replication of the system
5. Conclusion
## Issues relevant to migration of HHS

<table>
<thead>
<tr>
<th>Issue</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet infrastructure and technology</td>
<td>cloud service provider</td>
</tr>
<tr>
<td>Penetration rate of WeChat</td>
<td>Line, Facebook</td>
</tr>
<tr>
<td>Cost-effectiveness analysis</td>
<td>3 million CNY (~$431K USD) for HHS</td>
</tr>
<tr>
<td></td>
<td>the infection rate, social distancing and traffic control</td>
</tr>
<tr>
<td>Resources for implementation of the new system</td>
<td>connecting with hospital information systems and data analytics are challenging</td>
</tr>
<tr>
<td></td>
<td>required coordination of local and external resources.</td>
</tr>
</tbody>
</table>
Acknowledgement

- Professor Zhu Hong, Chairman of Nanfang Hospital
- Professor Liu Li, Chief of Quality Control Dept, Nanfang Hospital
- Professor Sun Jian, Dept of Infectious Diseases, Nanfang Hospital
- Dr. Shi Wenzhao, CEO of DCHealth Technologies
- All the patients and residents of Honghu involved in the study
- All the team member of Guangdong Medical Aid Team to Honghu
- The DCHealth medical team and technical team
Thank you.
gmc@nrdrsr.org
Using data and data visualization during the COVID-19 response in Vietnam
DIGITAL HEALTH AT PATH and our response to COVID-19 in Vietnam
Outline

• PATH in Vietnam
• Digital health in Vietnam
• Strategy (interoperability / data sharing and exchange)
• COVID-19 tracking system
PATH has been working to support local partners in Vietnam for 40 years.

Our health focus areas in Vietnam:
- vaccine preventable diseases,
- infectious diseases,
- noncommunicable diseases (NCD), and
- global health security (GHS),
- with a cross-cutting focus on digital health and health systems strengthening.

Current digital health projects:
- AMR and HAI surveillance portals, ARBOR, SARI, incident-based (eCDS) and event-based surveillance (GHS-CDC)
- National Immunization Information System (BMGF)
- NCD eHTN.Tracker (Access Accelerated)
Digital health in Vietnam

- Lack of technical guide: have standard requirements but no technical guide to practically implement.

- Fragmented data: too many different applications developed by various providers without standard for data exchange or sharing (e.g. HIS, EMR, EHR, NIIS).

- Some surveillance systems have pushed data to data warehouse (e.g. eCDS, SARI, and ARBOR).

- Government of Vietnam/MOH: strong request to solve these issues and still looking for a commander (pioneer).

HIS: Hospital information system
NIIS: Nation immunization information system
EMR, EHR: Electronic medical records, electronic health record
eCDS: epidemic communication disease system
Strategy (interoperability / data sharing and exchange) suggested by PATH in Vietnam
COVID-19 tracking system

Main purpose:

• to manage patient data and tracking
• to track situation of COVID-19 in Vietnam
• to provide data to support the MOH make evidence-based decisions, e.g. predicting outbreak location, tracking patient health status, purchasing diagnostic test kits.
Data flow

Data source

Concentrated quarantine zone

Health facility

Vietnam health declaration
API is ready, waiting share data from other provider

Data use

Reporting

Visualization
Functioning

Management
- ✔ Personal information
- ✔ Epidemic factor:
  - ✔ Confirmed case
  - ✔ Contacted case
- ✔ Case investigation and contact tracing)
- ✔ Anamnesis

Reporting
- **Following decision 963/QĐ-BYT**
  - ✔ daily report
    - list of confirmed case
    - list of close contact case with confirmed case
    - Summary report

Visualization
- ✔ Number of case
  - ✔ Whole country
  - ✔ Provincial
- ✔ Percentage by ratio
Demo Source Health worker Tracking system

Concentrated zone

Health facility

Home
Data visualization

Recovered: 75
Treatment: 158
Confirmed: 233
Suspected: 4,557
Network graph of confirmed case
Technology used

Windows server and IIS

Backend: ASP.NET, SQL

Front end: Angular

Google data studio, amCharts
THANK YOU.

Tuan Ngo

tngo@path.org
The View from South Korea & Singapore

Hamish Fraser, MBChb, MSc, FACMI
South Korea: 10,284 cases/51M

- First cases for covid-19 seen on January 20th
- Rigorous response to outbreak based on techniques developed for MERS in 2015
- Strong focus on traditional principles of screening, contact tracing and contact management
- Early and high rate of testing for covid-19
- Used records of medical facilities, phone based GPS, card transactions and CCTV
- Symptom monitoring
- Protocols developed to protect privacy of data

Singapore: 1309 cases/5.8M

- One of the first countries affected by covid-19
- Started temperature screening at airports on Jan. 3rd
- First known case Jan. 23rd, with highest case count outside China from Feb. 5th to Feb. 18
- National pandemic preparedness plan and new national center for infectious disease
- Laboratory testing capacity scaled up early
- Case surveillance based on clinical criteria at health facilities, pneumonia cases, and ICU patients
- All suspected and confirmed cases isolated in hospital, mandatory 14 day quarantine for contacts
- Strict quarantine rules and financial support
Singapore: TraceTogether app

TraceTogether uses Bluetooth to identify who you have been with rather than where you have been.

Audience Q&A
AMIA 2020
COVID-19 Webinar Series
Informatics matters. Now more than ever.

– Two additional webinars this week
  • Role of Clinical Informatics in COVID-19

– Visit AMIA.org/COVID19