A digital community-based syndromic surveillance system for influenza and other acute respiratory infections in Singapore

Yap Peiling

Infectious Diseases Research and Training Office (IDRTO)

21st February 2019
Influenza in Singapore

Brief background

• Worldwide, influenza epidemics account for approximately 3 to 5 million cases of severe illnesses every year.

• Influenza affects nearly 20-25% of Singapore’s population.

• About 1500 people are hospitalized and 588 die each year due to influenza.

• The treatment-only strategy has resulted in 690 simulated deaths, 13,950 hospital days and 2.5 million workdays equivalent lost per year.

• Being a global hub for travelers, pandemic threats from other respiratory infectious diseases also continue to emerge.
WHO recommends comprehensive surveillance ranging from community to national hospitals.

Traditional methods rely on symptomatic person visiting a healthcare facility --- not efficient.

A digital community-based syndromic surveillance system might address the base of the surveillance pyramid.
Community-based surveillance systems

*FluMob and FluTac*

- Monitor influenza-like illness (ILI) symptoms among healthcare workers.
- Collection of biological samples from participants.
- Feasibility of monitoring influenza-like illness (ILI) symptoms among working adults on a weekly basis.
FluMob

Study objectives and design

• To pilot test a syndromic surveillance system, which can provide early warning and real time monitoring of influenza and other respiratory infectious diseases among healthcare workers.

• Longitudinal prospective cohort with a follow-up period of 18 months from baseline.

• 700 healthcare workers from 2 major hospitals, Tan Tock Seng Hospital (TTSH) and Kandang Kerbau Hospital (KKH).

• Study participants have to be 21 years old and above and own an Android or IOS phone.

• Collection of biological samples from participants with ILI symptoms.
1. **Download app** to your smart phone (Android and IOS versions available)

2. **Register** and create a user profile, a one-off step which takes about 15 mins
3. Submit a **weekly survey** on ILI symptoms, which will take less than 1 min if you have no symptoms and about 10 mins if you have symptoms.

4. Tracking of the study incentives and helpful reminders to fill in weekly survey.
FluMob

Study procedures - overview

- Study incentives provided for 12 months
- Incentive-free for 6 months

Weekly reporting via FluMob app for 18 months

Recruitment → Participant developing ILI symptoms → Report via app within 7 days after onset of symptoms → Contacted by study team to provide biological samples → End of study
FluMob

Study procedures - recruitment

- Provision of written informed consent by each participant.

- Baseline questionnaire (incorporated into app):
  - Demographic details (e.g., date of birth, sex, ethnicity)
  - Workplace information (e.g., job category, department)
  - Household information (e.g., age of family members)
  - Lifestyle behaviors (e.g., mode of transport to work, tobacco consumption)
  - Medical history (e.g., vaccination records)
  - Technology use and acceptance

- Recruitment of 700 participants took place between April-September 2016.
FluMob

Study procedures – samples provision

• Each participant will be reminded to report if they have/don’t have any ILI symptoms through the FluMob app every week for 18 months.

• Upon reporting ILI symptoms via the app, the participant will be contacted by the study team to provide biological samples.

• For participants willing to provide samples:
  • Visit 1: To provide nasopharyngeal swab and/or 5ml acute blood sample within 7 days after symptom onset.
  • Visit 2: For those who provided blood at visit 2, they will have to provide another 5ml of convalescent blood sample 21 days after symptom onset.

• PCR characterization of virus in samples subsequently performed.
FluMob

Preliminary results - demographics

• Final dataset consists of complete information from 690 participants
FluMob

Preliminary results - demographics

**ETHNICITY**

- CHINESE: 56.4%
- MALAY: 12.2%
- INDIAN: 13.7%
- OTHERS: 17.7%

**FLU VACCINE IN THE PAST 1 YEAR**

- YES: 81.7%
- NO: 18.3%
FluMob

Preliminary results - demographics

Job categories of participants

- Majority of the participants are from nursing and allied health (68%).
- 96.1% of them are non-smokers.

Nursing 41%
Allied Health 27%
Ancillary 15%
Administration 7%
Medical 9%
Others 1%
FluMob

Preliminary results – Reporting rate

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Flu surveillance systems

Technical glitch and server was shut down
FluMob

Preliminary results – Reporting rate

Weekly reporting rate (%)

Study week

% of participants
**FluMob**

*Preliminary results – ILI symptoms reported*

- **Top 5 symptoms reported are:**
  - Runny/blocked nose
  - Sore throat
  - Cough
  - Sneezing
  - Malaise

- **Distribution of co-symptoms:**
  - 1-2 symptoms: 43%
  - 3-4 symptoms: 34%
  - ≥5 symptoms: 23%
FluMob

Preliminary results – Positivity rate

Positivity Rate of FluMob Data vs TTSH lab influenza cases

- Blue line: Reported ILI symptoms on FluMob
- Orange line: Lab-confirmed influenza cases among TTSH patients

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FluTac

Study objectives and design

• Develop an interactive mobile application, which can collect epidemiological data on influenza and other acute respiratory infections from users and also provide feedback data to them.

• Pilot test and evaluate the use of such a syndromic surveillance system in working adult cohorts who are at higher risk of exposure to influenza and other ARIs.

• Study lasted for 4 months (May – September 2018) and evaluated among working adults from the airport and food and beverage industries.
FluTac

Mobile app features

Navigation

Homescreen
- App features

Side Menu
- Account settings
FluTac

Mobile app features

Weekly survey

If you are well
- Four simple questions

If you are unwell
- A few more questions about your symptoms and medical treatment

Survey

Have you traveled outside of Singapore within the last 1 week?
Select

Have you had any of the following symptoms in the past 1 week?
Select

What symptoms do you have? (Tick all that apply)
- Chest pain
- Chills/Rigors
- Coloured sputum/phlegm
- Cough

Analytics

- Tracking of weekly health scores

Your average health score is 61
FluTac

Mobile app features

Mapping

Nearby GP Clinics
- All clinics
- 24hr clinics

Flutac-klers
- Reported cases in the 5 regions
FluTac

Mobile app features

Flu facts

Influenza A and B cause symptoms such as fever, chills, headaches, runny nose, sore throat and cough, while influenza C causes milder symptoms such as fever, cough and runny nose only. (Canada MOH, 2012)

Diagnosis
Symptoms
Prevention
Treatment
Stats
History

Ministry of Health and Health Promotion Board recommend children (6 months – 5 years) and elderly (> 65 years) to get yearly flu vaccines. Since 2014, people at high risk of flu-related complications can use Medisave for their flu vaccination. (’Doctor, I have flu…’ TTSH, 2015) (’Ministry of Health’, 2010)
FluTac

Mobile app features

Incentives tracking

Individual

Survey Tracking

Well done!

2 surveys done

Option 1: For every survey completed, SGD $1.00 will be awarded.
Option 2: For 30 surveys or more completed, a maximum of SGD $30.00 will be awarded.
Option 3: When 80% of your company have completed the weekly surveys, SGD $70.00 will be awarded to you.

Company

Company Survey Tracking

5 surveys done

Option 1: For every survey completed, SGD $1.00 will be awarded.
Option 2: For 30 surveys or more completed, a maximum of SGD $30.00 will be awarded.
Option 3: When 80% of your company have completed the weekly surveys, SGD $70.00 will be awarded to you.
FluTac

Reimbursement scheme

REIMBURSEMENT SCHEME

Individual and Company

INDIVIDUAL

• $1 for every survey submitted

INDIVIDUAL

• For 20 surveys submitted, $30 will be given instead

COMPANY

• For total submission rate of 80% and above, $70 per person will be given instead
**FluTac**

*Preliminary results*

- **Vaccination rate:**
  - Only 2.7% were vaccinated for flu in the past 1 year.
  - 56.5% had a flu vaccine before.
  - 40.8% never had a flu vaccine before.

- **Reporting rate:**
  - Total number of weekly surveys submitted within 4 months: 1281
  - Average number of surveys per individual: 12
  - Reporting rate: 74.1%

- **Positivity rate:** 12%
Moving forward

• Integration of Singapore data with data from other community-based surveillance systems in Australia (Flutracking), US (FluNearYou) and Europe (Influenzanet).

• Expansion of FluMobTracker to the regional countries (Pilot testing in Sri Lanka in collaboration with University of Colombo).

• Community-based surveillance of both flu and vector-borne diseases (e.g., dengue and zika).
Acknowledgements

- **NCID**: Brenda Ang, Tan Yi-Roe, Xu Huarong, Liow Yaw Shen
- **NTU**: May O Lwin, Kosala Subasinghe, Karthikayen S/O Jayasundar, Anita Sheldenkar
- **NUS**: Alex Cook, Alexius Soh

Thank you for your kind attention!