Epidemiology and surveillance in a pandemic: questions to guide the public health response

Richard Pebody
Centre for Infectious Disease Surveillance and Control
Public Health England England
Key critical epidemiological issues: new emerging pandemic

Clinical course?

Case-severity?

Transmissibility?

Population impact?

Effect of mitigation measures?
Overall aim of pandemic surveillance

To describe the nature, severity, trends and impact of pandemic influenza, and the uptake, impact and effectiveness of mitigation measures so as to enable timely evidence-based policy making and inform the health service and public.
Overall aim of pandemic surveillance

To describe the nature, severity, trends and impact of pandemic influenza, and the uptake, impact and effectiveness of mitigation measures so as to enable timely evidence-based policy making and inform the health service and public.

KEY LINK TO MODELLING AND ECONOMIC EVALUATION
Objectives of pandemic surveillance

To undertake an initial rapid assessment of the clinical, epidemiological and virological features of the earliest cases of a pandemic influenza virus;

To estimate the case-severity and transmissibility of the virus;

To track the evolving pandemic including geographical spread and trends;

To measure population impact;

To measure uptake, impact, safety and effectiveness of various counter-measures.
Key objectives

Characterisation of first cases and their close contacts

- clinical presentation
- epidemiology (e.g. transmissibility)
- virology (e.g. period of shedding)

Characterisation of first severe (hospitalised and fatal) cases

- clinical presentation (e.g. 2\textsuperscript{o} bacterial infections)
- case-severity (CHR, CFR e.g. by age)
- risk factors for severe disease
Key objectives

Spread and impact of pandemic
- start (e.g. detect onset of community transmission) and spread
- impact (e.g. excess mortality)

Modelling and economic evaluation
- estimation of key parameters (e.g. R, serial interval etc.)
- real-time modelling -> predict timing and burden of flu
- model interventions (e.g. pandemic vaccine programme strategy)

Effectiveness, safety and acceptability of interventions
- non pharmaceutical (e.g. social distancing)
- anti-virals (prophylaxis and treatment)
- influenza vaccines (pandemic, seasonal)
Influenza pyramid: sources of data

- Deaths
  - Hospitalised cases
  - Community cases seen in health-care
  - Community cases not seen by health-care service
  - All infections in population

- Mortality monitoring
- Severe Influenza Surveillance system (USISS)
- NPFS surveillance
- Telephone survey
- Field investigations
- Flusurvey
- Sero-surveys (e.g. FF100, outbreaks, residual survey)
Influenza pyramid: sources of data

Deaths

Hospitalised cases

Community cases not seen by health-care service

All infections in population

Mortality monitoring

Severe Influenza Surveillance system (USISS)

NPFS surveillance

Telephone survey

Field investigations

Flusurvey

Sero-surveys (e.g. FF100, outbreaks, residual survey)

LINK TO VIROLOGY
Timing of early, middle and late stage assessments in relation to the epidemic curve within a country

- Transmissibility
- Case-severity
- Impact
- Mitigation
Severity Assessment

Transmissibility - early

- Number of symptomatic cases (in time, place, person)
- Household secondary attack rate
- Basic reproduction number (R0)
- Generation time
- Serial interval
- Attack rate in closed populations

CASE REGISTER SYSTEM
FIRST FEW HUNDRED CASE-CONTACT SYSTEM
FIELD INVESTIGATIONS
MODELLING
Severity Assessment

Case severity - early

- Pre-existing population immunity
- Case-fatality ratio (CFR)
- Case-hospitalisation ratio (CHR)
- Proportion of flu admissions, ICU admissions and deaths with pre-existing medical conditions
- Proportion of flu hospital admissions that require ICU admission or die

Surveillance and Epidemiology during Pandemic, Jan 2014
Severity Assessment

Impact - early

- Hospitalisation rate
- Proportion of ED visits attributed to influenza
- Proportion of hospital beds occupied by patients with influenza
- Proportion of ICU and ECMO beds occupied by patients with influenza
Severity Assessment

Transmissibility - later

- Infection attack rate
- Disease incidence rate

SERO-PREVALENCE STUDIES
FIELD INVESTIGATIONS
TELEPHONE SURVEY
DAILY SURVEILLANCE DATA
REAL-TIME MODELLING
Severity Assessment

Severity - later

- Number of deaths
- Number of excess deaths compared with previous seasons or pandemic events
- Proportion of cases asymptomatic/mild illness/severe illness/die

MORTALITY MONITORING

CASE-CONTACT SEROLOGIC STUDIES

FIELD INVESTIGATIONS INCLUDING SEROLOGY
Impact - later

- Interruption of critical infrastructure and services
- Work and school absenteeism
- Gross Domestic Product
- Tourist visitor numbers and expenditure.
- Border, travel and trade actions by countries
- Nature of public perception
## Mitigation measures

- Uptake of pandemic vaccine in target groups
- Effectiveness of pandemic vaccine
- Safety of pandemic vaccine
- Uptake and effectiveness of antivirals
- Impact of non-pharmaceutical interventions e.g. school closures

**MODELLING & ECONOMIC EVALUATION**

**UPTAKE MONITORING**

**VE MONITORING (TNCC, COHORT)**

**SAFETY SURVEILLANCE & STUDIES**

**FF100, FIELD STUDIES**
Conclusions

Key role of surveillance and epidemiology in rapid assessment at all stages of new emerging pandemic for timely contributions to inform policy

Critical link to virology and modelling and economic evaluation (SPI-M)

Range of post-2009 pandemic surveillance strengthening initiatives e.g.
- Severe disease surveillance
- Community surveillance
- Sero-epidemiology
- FF100

Central role of NIHR funded initiatives e.g. real-time modelling

International dimensions (WHO, ECDC) and networks (e.g. ConCISE)