SARS

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Chain of transmission among guests at Hotel M—Hong Kong, 2003

Data as of 3/28/03

* Health-care workers; † All guests except G and K stayed on the 9th floor of the hotel. Guest G stayed on the 14th floor, and Guest K stayed on the 11th floor; § Guests L and M (spouses) were not at Hotel M during the same time period as index Guest A, but were at the hotel during the same times as Guests G, H, and I, who were ill during this period.
A brief history of SARS
Probable cases of severe acute respiratory syndrome (SARS) with onset of illness November 2002 to 31 July 2003.
The problem...

- Rapid international spread of an unknown agent
- SARS caused unprecedented levels of morbidity and mortality among HCW
- Health systems exhausted and almost exceeded surge capacity
- Transmission events from recognised and unrecognised cases
Emergence factors – SARS-CoV

- Genetic change in an animal coronavirus?
- Adaptation of existing virus to new hosts and inter-species transmission?
- Changes in agriculture and animal husbandry practices
- Human behaviour – the exotic wildlife trade

- **27 November**
  - Guangdong Province, China: Non-official report of outbreak of respiratory illness with government recommending isolation of anyone with symptoms (GPHIN)

- **11 February**
  - Guangdong Province, China: Report from the MOH of an outbreak of atypical pneumonia

- **14 February**
  - Guangdong Province, China: Official confirmation of an outbreak of atypical pneumonia with 305 cases and 5 deaths (China)

- **19 February**
  - Hong Kong, SAR China: Official report of 33-year male and 9 year old son in Hong Kong with Avian influenza (H5N1), source linked to Fujian Province, China (FluNet)
Intensified surveillance for pulmonary infections, WHO 2003

26 February
- Hanoi, Viet Nam: Official report of 48-year-old business man with high fever (> 38 °C), atypical pneumonia and respiratory failure with history of previous travel to China and Hong Kong

4 March
- Hong Kong, SAR China: Official report of 77 medical staff from Kwong Wah Hospital reported with atypical pneumonia

5 March
- Hanoi, Viet Nam: Official report of 7 medical staff from French Hospital reported with atypical pneumonia

15 March
- Singapore and Ontario: Official reports of atypical pneumonia fitting same case definition

WHO Global Alert
SARS – why it was different

- Rapid spread with HCW at high risk
- High case fatality
- Unknown aetiology
- No specific therapy
- Rapid international spread
- North-North transmission pattern
- Time pressure/window to eliminate
Factors affecting the epidemiology and size of the 2002-03 epidemic

- Delayed verification of the epidemic in Guangdong
- International travel
  - Hotel M seeded the outbreak outside Guangdong province
  - Random event, undetermined route(s) of transmission
- Superspreading events
- Transmission amplification in health care settings
- HCW behaviour (infection control practices, working while ill in some settings)
- Atypical presentations seeding new outbreaks
Descriptive epidemiology

- 8098 cases; 53% female, 21% healthcare workers
- 774 deaths attributed to SARS; global CFR 9.6%
- 20-25% of cases required intensive care
- All age groups affected (age range 0-100 years, median age 40 years)
- Adult case fatality age dependent - range 0% to >50% in cases >55 yrs
Routes of transmission

- Infectious dose unknown
- Droplet and contact transmission primary routes
- Animal-to-human transmission – exact mechanism unknown
- Evidence of limited aerosol spread e.g. hospital and airline data
- Other environmental contamination e.g. Metropole Hotel, Amoy Gardens
Risk factors for hospital-acquired SARS

- Virus characteristics
- Delayed recognition of cases
- Failure to recognise clusters
- Delays in isolation or failure to isolate
- Missed cases, especially if presentation atypical
- PPE not used or PPE breakthrough
## SARS transmission - HCWs

<table>
<thead>
<tr>
<th>Areas</th>
<th>Total cases</th>
<th>Case fatality ratio (%)</th>
<th>Number of HCW affected (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>251</td>
<td>17</td>
<td>109 (43)</td>
</tr>
<tr>
<td>China</td>
<td>5327</td>
<td>7</td>
<td>1002 (19)</td>
</tr>
<tr>
<td>China, Hong Kong SAR</td>
<td>1755</td>
<td>17</td>
<td>386 (22)</td>
</tr>
<tr>
<td>China, Taiwan</td>
<td>346</td>
<td>11</td>
<td>68 (20)</td>
</tr>
<tr>
<td>Singapore</td>
<td>238</td>
<td>14</td>
<td>97 (41)</td>
</tr>
<tr>
<td>Vietnam</td>
<td>63</td>
<td>8</td>
<td>36 (57)</td>
</tr>
</tbody>
</table>
Risk factors (cont)

- The number of SARS cases admitted
- Type of HCW
- Incomplete contact tracing
- Involvement in high risk procedures
- Transfer of patients
- Transport of patients
SARS superspreading events

Controlling the SARS epidemic

- Effective “traditional” public health measures implemented before aetiological agent known
- Active case finding, case isolation and case management
- Stringent infection control and use of PPE
- Contact tracing, contact education and voluntary home quarantine
- Applied research (clinical, laboratory, epidemiology)
- Transparency and risk communication
- Continued vigilance through effective surveillance
SARS - coordination and communications through networks

- GOARN: multi-country field response
  - 115 experts from 26 institutions in 17 countries

- Virtual network for SARS aetiology
  - 13 laboratories in 9 countries

- Virtual SARS network of clinicians
  - 50+ clinicians in 14 countries

- Virtual network of epidemiologists
  - 32 epidemiologists, 11 institutions, daily telephone conference

- SARS Modelling group
## GOARN Deployments

<table>
<thead>
<tr>
<th>Country</th>
<th>Persons Deployed</th>
<th>Total Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>PR China</td>
<td>28</td>
<td>643</td>
</tr>
<tr>
<td>Hong Kong SAR</td>
<td>9</td>
<td>198</td>
</tr>
<tr>
<td>Singapore</td>
<td>7</td>
<td>111</td>
</tr>
<tr>
<td>Vietnam</td>
<td>11</td>
<td>372</td>
</tr>
<tr>
<td>Others</td>
<td>6</td>
<td>343</td>
</tr>
</tbody>
</table>

61 Deployments 1,667 Days

51 Individuals * 6.5 work-years

* In addition, 16 WHO HQ staff were deployed to seven countries
WHO and SARS - communications

- Guidelines and technical info on website continually updated
- Zoonotic group
  - links with OIE and FAO
- Communication group
  - 14 press releases, 13 press conferences, numerous interviews
  - up to 3,500 press stories per day
  - 62 Web situation reports
  - up to 10 million hit per day
- Global WHO Senior Management Group - met daily
  - telephone conference twice a week (HQ, ROs, WROs)
  - 18 travel recommendations
The course of the epidemic

Probable cases of SARS by week of onset
Worldwide* (n=5,910), 1 November 2002 - 10 July 2003

WHO issues travel advisory 15 March
WHO issues global alert 12 March

* This graph does not include 2,527 probable cases of SARS (2,521 from Beijing, China), for whom no dates of onset are currently available.
SARS since 5 July 2003 (n=17)

- Difficult to predict whether SARS will re-emerge in epidemic form

- 4 SARS alerts since then; 3 resulting from breaches in laboratory biosafety, one possibly from transmission from a putative animal reservoir
SARS transmission
Laboratory incidents

- Singapore, Aug-Sept 2003 (n=1)
- Taipei, December 2003 (n=1)
- Beijing & Anhui province, March 2004 (n=11)
- Focussed attention on need to enhance laboratory biosafety world-wide
Lessons learnt from SARS
The impact of SARS

- First recognized as a global threat in mid-March 2003
- International spread of SARS successfully contained in less than four months
- International community challenged
- $US30-140 billion economic cost
- $R_0 \approx 2-4$ before control measures were implemented i.e., not a highly infectious disease
- Revision of IHR - global governance
SARS and globalisation

- Potential for international spread greatly amplified in an interconnected world.
- Economic consequences likewise amplified.
- Severe new diseases - emergencies that exceed the surge capacity of countries and regions.
- International networks – rapid response, surge capacity, technical cooperation.
- National and international systems must interconnect
International Health Security
IHR(2005), a paradigm shift

From **control at borders** to **containment at source**

From **diseases list** to **all threats**

From **preset measures** to **adapted response**
Annex 2 Decision instrument

Events detected by the national surveillance system

- Four notifiable diseases
- Any public health event of potential international public health concern
- Important epidemic-prone diseases

Is the public health impact of the event serious?
Is the event unusual or unexpected?

ask
1. Is there a significant risk of international disease spread?
2. Is there a significant risk of travel or trade restrictions?

If yes to any of these 2 questions
Notify WHO under the IHR (2005)

The IHR (2005) came into force on 15 June 2007
Improving detection and assessment

- Ever increasing number of search engines and information sources – information overload
- Challenges
  - Boost signal, reduce noise
  - Improve positive predictive value of incoming information
  - Move from threat detection to systematic and scientific risk assessment
  - ICT innovations for epidemic threat detection, data retrieval and synthesis
  - Disciplines and tools for decision support
  - Information systems for data capture, communication between countries, Regions, and HQ - EMS, EIS
  - IT tools for data analysis to support field response - FIMS
Lessons for Operations

- Preparedness for alert and response operations
  - High level political commitment to strengthening national and international disease control capacity
  - Clear command and control structures
  - Systematic operational and risk communications systems
  - Multidisciplinary teams trained in field response

- Courage to make and implement decisions rapidly and effectively, often with limited information
Building on lessons learnt – an iterative process

- Evaluation of the measures used during the epidemic to strengthen the evidence base
- Modelling studies to determine which interventions worked and when
- Discarding measures that were not cost-effective (e.g. entry screening)
- Building key elements into future outbreak responses
Key issues in preparedness planning

- Assessment of the risk of emerging infectious diseases
- Minimum level of preparedness
- Criteria/indicators to assess the value of preparedness activities
- Ranking the [cost-]effectiveness of facility-based and public health interventions
- Optimal timing of public health interventions
- Feasibility, affordability, and acceptability of public health vigilance
- Determining the best bang for the buck
Health Security Issues (1)

- “Inverse vulnerability”
- Government credibility and civic order
- Economic impact
- Urgency of decision-making
- Information management and risk communication
- Border permeability and effectiveness of public health measures
Health Security Issues (2)

- Protecting healthcare delivery systems during the crisis
- Defensible public health standards for epidemiology, laboratory diagnosis, safe clinical management, and infection control
- Protecting public safety - ethics and acceptability of control measures
- International co-ordination post-event: surveillance, scientific exchange, prophylaxis, therapeutics, fostering applied research for public health needs - incl. prospective research planning
For discussion

- No country, advanced or developing, has adequate systems in place to control a fast spreading, new, epidemic disease

- SARS was controlled, but through a massive international effort which stretched WHO and countries to the limit, and would not be sustainable over a prolonged period

- Many countries now developing early warning systems, but the requirements for containment demand also the public health knowledge and infrastructure to manage the event
For discussion

- Containment of the health impact of natural, accidental or deliberately caused outbreaks can only be achieved through operationally-focused public health infrastructure.

- Investment in systems is needed at national and international levels.

- Collaborative networks and multisectoral approaches offer the most resilient and cost-effective prospects.

- Modelling, behaviour change and effective risk communication will be key to social mobilisation for control.
THANK YOU