Institute on Science for Global Policy

# Planning for Pandemics: The Formulation of Policy**

Roy Anderson, F.R.S., F.Med.Sci.
Chair of Infectious Disease Epidemiology, Department of Infectious Disease Epidemiology,
Faculty of Medicine, Imperial College London

## Summary

The historical and epidemiological literature abounds with accounts of infectious disease epidemics and of the concomitant effects on population abundance, social organization and the unfolding pattern of historical events. Epidemics have long been a source of fear and fascination in human societies, but it is only in comparatively recent times that their origins and patterns have begun to yield their secrets through scientific study.

## Current realities

The World Health Organization (WHO) has guidelines for defining a pandemic and on epidemic and pandemic alert and response (WHO, 2009). These guidelines are under revision following the 2009 H1N1 pandemic (PDM 2009 H1N1), in which guidance was largely based on patterns of spread from country to country, rather than spread and pathogenicity combined. Some novel infectious agents spread worldwide, but induce little impact on human health (e.g., many common cold viruses), whereas others are highly virulent (e.g., severe acute respiratory syndrome [SARS]).

Methods of analysis and interpretation for epidemics have advanced rapidly in recent years with many mathematical and computational tools available to predict spread, control impact, and define an optimal mitigation intervention package based on the available tools.

The SARS epidemic was handled well by the international community and controlled rapidly as a consequence. However, for various biological and epidemiological reasons, this was an easy pathogen to control by simple public health measures such as quarantine and patient isolation. Pathogens like influenza A are much more difficult to control due to rapid spread and short generation times (i.e., a few days). An error in handling the recent H1N1 pandemic was a failure to rapidly establish (by serological studies) the case fatality and serious morbidity rates for the new viral strain. If the fact that these were no higher than a typical seasonal influenza strain had been understood in a timely manner, the global response may have differed greatly to that which was put in place.

## Scientific opportunities and challenges

The study of epidemic pattern and disease control has advanced in the past few decades from observation, through theory, to experiment and prediction. Increasingly, the concepts of evolution are embedded in the analysis of epidemics and this is especially so for pandemics of the influenza viruses. An increasing understanding of process and pattern in the emergence of pandemics has concomitantly resulted in better planning and policy formulation. Retrospective analysis of both the recent PDM 2009 H1N1 influenza epidemic and the preceding problem of SARS, which emerged in 2003, provides policy makers with guidance on what went well and what could be improved upon.

Early indications of a new pathogen's emergence are based on reports of unusual clusters of morbidity and mortality in space and time. Collation of such reports in real time is still primitive in the international practice of public health compared with other sectors such as meteorology, oceanography, and financial services. Even within very rich countries, digital data capture in real time is still an ambition rather than a reality. Current surveillance is based on Web-based searches of the media, in as wide a range of countries as possible, using algorithms that identify reports of unusual morbidity and mortality.

Once the clusters of disease cases are believed to be caused by an infectious agent, the key tasks are many and varied. These are summarized in Box 1. Identification and the demonstration of Koch's postulates (four criteria for establishing whether a specific organism is the cause of a particular disease) is the starting point and other tasks can be initiated simultaneously. The SARS pandemic well illustrated the power of international collaboration, which was demonstrated by the combined efforts of WHO, existing university linkages, and professional bodies.

Mathematical and computational tools, which are more akin to the methods employed in the physical and engineering sciences, have had slow uptake in many public health and medical circles. Many still rely on a consensus arising from verbal discussions in advisory committees rather than on quantitative analysis.

At the earliest stages of the emergence of a novel agent, focus is typically on diagnosis and treatment. Treatment may not be an option for some time (e.g., perhaps six months at a minimum for a vaccine and longer for a drug) given the development delays in producing drugs and vaccines even in an emergency. Often forgotten is the need to measure key epidemiological variables that determine rates of spread, impact of possible public health interventions (e.g., quarantine), and the possible time scale of global spread. For the SARS virus responsible for the 2003 epidemic, some of the key variables and their estimated values are listed in Box 2. Once these are measured, analyses of optimal disease mitigation interventions and their timings of introduction can be made.

## Policy issues

Policy formulation for the control of an emerging pandemic is complex and will depend on many factors.

- The study of epidemic patterns and options for disease control needs to be conducted at regional, national, and international levels, since policy formulation and its implementation varied widely in recent pandemics. For both national and international policy makers improving such surveillance should be an urgent priority.

- Assembling the world's leading scientists and medical researchers to provide a reliable information source for both national and international policy formulation is an urgent necessity. Governments often assemble national committees, irrespective of the expertise level within a country. A much better approach is to recognize that expertise from around the world should be integrated and used by all countries under the umbrella of an international agency — provided it chooses membership of an advisory committee on expertise and not international representation. Amongst the experts (e.g., influenza specialists in the case of an emerging influenza pandemic), it is essential to add generalists as well, since conventional wisdom in a narrow field can sometimes prove to be wrong! Broad expertise on advisory committees crossing infectious disease specialists, epidemiologists, clinicians, logistics experts, and communication people is essential.

- Alert levels must be based on case morbidity and mortality rates and decisions on what levels might require international alerts and actions.

- Policy makers need to ensure that the most modern tools, including mathematical models and simulation techniques, are used to guide recommended actions. These results then need to be modified in policy formulation by what is possible and what can be afforded.

- In recent epidemics and pandemics it has rarely (if ever) been clear what the main policy objectives are in national and international intervention efforts to mitigate disease. Policy objectives for mitigating infectious disease epidemics and pandemics should be transparently delineated. Some examples of possible policy objectives are listed in Box 3**.**

- Recent analyses suggest that some policy options for the control of epidemics conflict with other policy proposals. For example, it may not be possible to minimize the peak and duration of an epidemic with one set of interventions since "squashing" the peak tends to lengthen the duration of the epidemic (Hollingsworth et al., 2011). As such, policy makers need to be encouraged to list objectives in order of priority if all cannot be satisfied by the available intervention options, or if they conflict because of the dynamics of epidemic spread. The art of the possible is always a key issue in what can be done to mitigate impact as reflected in Box 4 for influenza A pandemics.

- Overall, the preceding recommendations highlight the key tasks for the policy makers: (i) establish the threat posed by the new infectious agent in terms of morbidity and mortality; (ii) assemble a panel of experts and "wise" generalists; (iii) identify what interventions are options and when they will be available; (iv) initiate simulating studies to see what works best and how much will it cost; (v) and, most importantly, define policy objectives clearly and in an order of priority.

**References**

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Hollingsworth, T. D., Klinkenberg, D., Heesterbeek, H., Anderson, R. M. *(2011).* Mitigation strategies for pandemic influenza A: Balancing conflicting policy objectives. *PLoS Computational Biology, 7*(2), 1–11.

*** A policy position paper prepared for presentation at the conference on Emerging and Persistent Infectious Diseases (EPID): Focus on Mitigation, convened by the Institute on Science for Global Policy (ISGP) October 23–26, 2011, at the University of Edinburgh, Edinburgh, Scotland.*

| Box 1: The emergence of a new infectious disease — urgent tasks |
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- Indication-unusual clusters of morbidity/mortality in space and time.
- Identify aetiological agent — demonstrate Koch's postulates.
- Develop a diagnostic test (serology and pathogen presence).
- Initiate research on drugs and vaccines — collaboration with pharmaceutical industry in diagnostics, treatment, and prevention.
- Activate data capture in real-time and communicate this information.
- Identify clinical algorithms for care of the sick.
- Identify and implement optimal public health measures for control.
- Keep public informed at all stages.

| Box 2: Key variables for SARS |
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- Exposure to onset of symptoms (incubation period): mean 4.2 days.
- Onset of symptoms to admission to hospital — reflects rapidity of diagnosis: decreased from an average of 4.9 days at the beginning of the epidemic to less than 2 days by the mid-point of the epidemic. This variable affects the efficiency of isolation and quarantine in reducing transmission.
- Admission to hospital to death (for patients who died): mean of 23.5 days. This variable helps define the burden likely to fall on the health care system as the epidemic develops.
- Admission to hospital to discharge (for patients who recover): mean of 23.5 days.

| Box 3: Policy objectives |
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- Minimize morbidity and mortality — with fixed or variable budget.
- Buy as much time as possible to wait for vaccine development.
- Minimize duration of the epidemic and impact on economy.
- Minimize peak prevalence below a defined level to avoid collapse of hospital care system.

| Box 4: Intervention options for influenza A |
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- Any mitigation strategy requires very early detection and a well- planned plus rapidly executed response. Rapidity of the introduction of an intervention will depend on the resources made available to cover the entire duration of the epidemic.
- For rapidly spreading pathogens (respiratory or fecal/oral route of transmission) restricting entry of travelers from regions in which the pathogen is spreading is ineffective unless put in place early and it acts to restrict over 99% of entries.
- Containment feasible to reduce peak incidence and the overall size of the epidemic using combinations of: prophylactic vaccines; antiviral agents to reduce morbidity/mortality and restrict the duration of infectiousness; increasing "social distance" by school/workplace/entertainment space closures, isolation, and travel restriction within a country.
- Simple public health measures such as the wearing of facial masks and hand washing.
- Key questions for analysis by policy makers: Is any combination of the above capable of mitigating the epidemic and by how much? What interventions are available to me? How much do they cost? What are the resources available? What is the best combination? When do I introduce them and for how long?