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MINI-SYMPOSIUM

Lessons learned from SARS: The experience of the Health Protection Agency, England

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Summary The United Kingdom was assessed as a low risk country throughout the 2003 global SARS outbreaks. Despite this, 368 reports of potential SARS cases were made to the Health Protection Agency (HPA) between March and July 2003. The public health actions undertaken in response to these reports, the establishment of reporting mechanisms and the development of guidance documents were substantial. Lessons learned from mounting a UK response to SARS included: the importance of international collaboration; formation of a UK-wide, multidisciplinary Task Force; flexible case reporting mechanisms; integration of surveillance and laboratory data; generation of prompt and web-accessible guidance and advice; availability of surge capacity; and contingency planning. Lessons learned are being incorporated into the HPA's preparedness to prevent and control future newly emerging infectious disease threats.

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Introduction

On 12 March 2003, the World Health Organisation (WHO) issued an unprecedented global alert regarding outbreaks of a severe pneumonia, subsequently characterised as Severe Acute Respiratory Syndrome (SARS), caused by the SARS-Coronavirus. SARS was the first new severe disease transmissible from person-to-person to emerge in the 21st Century. During the global outbreak, a total of 8096 probable cases of SARS and 774 deaths

were reported from 29 countries and areas.¹ China (mainland), Taiwan and Hong Kong Special Administrative Region (SAR) experienced substantial outbreaks, although considerable numbers of cases were also reported from Canada, Singapore and Viet Nam.¹

The United Kingdom (UK) was assessed to be at low risk from SARS throughout the outbreak.² Between March and July 2003, 368 reports of suspected SARS cases were made to the Health Protection Agency (HPA).² Of these, only nine were initially classified as probable SARS cases, and only one patient, a 23-year-old male, was positive for SARS coronavirus (Co-V) on PCR testing and later showed evidence of seroconversion. Nonetheless,

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the volume of work within the UK in response to SARS was far greater than suggested by the number of potential SARS cases reported to the HPA. In this paper, we summarise key elements to the UK public health response and lessons learnt from SARS.

Key components of the UK response to SARS

International collaboration

Collaboration at an international level was fundamental to the prompt recognition of SARS cases throughout the global outbreak. In response to requests for assistance from WHO and its partner, the Global Outbreak Alert and Response Network (GOARN), field teams were sent to locations in China, Hong Kong SAR, Taiwan, Singapore and Vietnam to assist with the investigation and management of outbreaks.

Given the unprecedented speed of electronic communication, continuous international liaison through secured web-sites, email and teleconferencing was essential to ensure that international and national public health agencies disseminated accurate and consistent information throughout the outbreaks. The global response to SARS provided new opportunities for the UK to collaborate with WHO (Geneva and Western Pacific Region), a number of public health organisations in south east Asia, as well as national public health centres such as the Centers for Disease Control and Prevention in the USA and Health Canada. The HPA has subsequently worked with colleagues in Hong Kong to establish a Centre for Health Protection (CHP) in light of recommendations of the Hong Kong SARS Expert Committee Report.³ There was also collaboration with the European Commission (EC), however, this was constrained by the lack of central capacity and experience in the Commission. It is intended that the new European Centre for Communicable Diseases will address this.⁴

Despite good levels of international collaboration, some aspects, such as global case reporting to WHO were problematic. Some countries did not contribute to the global dataset that was established to inform and refine evidence-based control measures, and there has been no systematic review of super-spreading events that occurred during the outbreak. The revision of the International Health Regulations (IHR) proposed by WHO in January 2004 provides a mechanism for strengthening early

and coordinated responses to outbreaks of international public health concern.⁵

Staff throughout the HPA and the UK Devolved Administrations undertook secondments abroad with WHO Geneva and WHO Western Pacific Region, which provided useful contact points for information and discussion. The HPA Enteric, Respiratory and Neurological Virus Laboratory (ERNVL), contributed staff to the multi-national team that identified the causative agent of SARS as a coronavirus, SARS-CoV, within 1 month of the WHO Global Alert being issued. The ERNVL has had subsequent involvement in the development of diagnostic tests for SARS-CoV. The HPA also contributed to the international surveillance response through the development of guidelines, research priorities and modelling activities.

Participation in teleconferences with WHO Geneva and the EC provided prompt access to information as it became available, and was beneficial to the HPA in informing and developing its response. More detailed epidemiology, laboratory and other working groups were also convened by WHO focusing on knowledge and lessons learnt from countries experiencing substantial outbreaks. The HPA played a major role in the international cohort study of the outbreak that occurred in a large Hong Kong hotel believed to have been pivotal to the initial international spread of SARS.⁶ One hundred and thirty-six UK residents who stayed at this hotel during the early stage of the outbreak were followed up. The convalescent sera of two patients tested positive for SARS-CoV antibodies.

Co-ordination of the UK public health response

The crucial trigger for the UK response were the Global alerts issued by WHO to all its GOARN partners, as well as more broadly. For the UK, the first substantive incident came at 04:00 on Saturday 15 March 2003 concerning the need to intercept a flight coming to Europe with a SARS patient on board. This event led to the formation of the UK SARS Taskforce, The Taskforce, chaired by the HPA, had representatives from the Health Departments, National Health Service (NHS), and national surveillance centres in England and the Devolved Administrations. It regularly convened by teleconference throughout the outbreak period. The invited participants included virologists, epidemiologists and specialist advisors on clinical infectious disease and infection control, as well as HPA communications staff.

The objectives of the Task Force included:

- Oversee and coordinate the surveillance of potential SARS cases
- Provide guidance on the management of cases and contacts
- Consider and recommend broader public health control measures
- Provide timely information to professionals and the public

Other specialist groups, such as the independent SARS Expert Advisory Group (EAG) were set-up to advise the Taskforce, the UK Health Departments and others on research and strategic issues arising. The UK Task Force was an effective mechanism for rapid exchange of information and expertise, and attaining consensus on operational issues and strategic response to SARS. A similar model has been employed during 2004 to address issues related to the outbreak of avian influenza in south east Asia. Discussions are underway to adopt the process more formally as a mechanism for the five nations (England, Scotland, Wales, Northern Ireland and Ireland) to respond in a co-ordinated manner to future public health threats.

Surveillance and laboratory testing of potential SARS cases

The Centre for Infections (CFI) co-ordinated surveillance of potential cases of SARS including the development and review of case definitions, establishing reporting mechanisms, and dissemination of data and information.⁷

The surveillance relied on passive reporting of potential cases by hospital and general practice physicians directly to the CFI by email, fax and telephone. Patients were classified according to HPA case definitions by CFI staff and the reporting clinician. Surveillance arrangements were revised during the outbreak to encourage initial alerting to HPA Regional Offices and ensure that local public health authorities were aware of the potential cases. Whilst central reporting allowed for prompt reporting and consistent classification of potential SARS cases, this mechanism of reporting would have been unsustainable in the event of a substantial UK outbreak when more responsibility would be devolved to regional staff, and CFI would concentrate on producing aggregate summaries.

UK case definitions were based on the WHO definitions, but were adapted to reflect the low level of risk in the UK. In order to prioritise the public health measures and laboratory investigation, the suspect case definition was aimed at

differentiating cases epidemiologically linked to a known probable SARS case from an affected area ('suspect-high'), from those who had travelled to an affected area but had no contact with a probable case ('suspect-low').² Priority investigation was given to cases assessed as probable, or suspect-high. Follow-up of clinical status was requested on all suspect and probable cases at 48 h, 10 days and weekly until recovery. Samples were collected for acute and convalescent (>21 days) sera for SARS-CoV antibodies. Follow-up generated substantial workload at national, regional and local levels.

Given the common and non-specific nature of initial clinical symptoms of SARS and the lack of diagnostic tests, the recording of a detailed epidemiological history of relevant travel or contact history was key to identifying potential SARS cases. Early detection and reporting of potential cases was subsequently found to be fundamental in limiting secondary spread in countries that experienced substantial outbreaks during the first SARS outbreak period.^{8,9}

Database development

Data collection and management of epidemiological and virological information undertaken by CFI required modification during the course of the outbreak. These systems, while appropriate for the low case load experienced, would have been limited in the event of an outbreak within the UK. Most importantly, the data were entered centrally and the system did not have the capacity for local staff to record and manage case reports or their contacts. Experience from Toronto suggests that for each case of SARS, health authorities should expect to quarantine up to 100 contacts, and to investigate eight possible cases.¹⁰ Data systems must have the capacity to report and track both cases and contacts.

Furthermore, an integrated virological and epidemiological database would have reduced the considerable time CFI and Regional Offices spent liaising with the laboratories to ensure that appropriate specimens had been submitted and that the laboratory could efficiently prioritise testing of specimens from cases by case definition. The challenge remains for the development of a real-time national database for an emerging disease which will facilitate all stages of reporting, link epidemiological, clinical, laboratory and contact tracing information and have the flexibility to evolve as information on the clinical presentation, potential risk factors, and implications for the follow-up of close contacts becomes available.

Guidance and advice

Provision of guidance and advice for healthcare professionals and the public formed an important component of the UK response to SARS during the outbreak period. The HPA website was the predominant mechanism for making guidance documents available in a timely manner.¹¹ Whilst the information and advice was generally well received, there are inherent difficulties in using a web site for disseminating information that is updated during an evolving situation. Users are required to undertake a proactive approach and check the website regularly for updates, which might prove particularly difficult in healthcare settings, where there is not regular access to the Internet within the workplace, or where there are regular changes of staff due to shift working. Furthermore, the constantly evolving situation highlighted the requirement to keep archives of web pages to create an audit trail of issued travel advisories and guidance documents.

There are also difficulties in maintaining an up-to-date web resource when regular updates are being published on other external sites. For example, in England, travel guidance for the public was published by a number of different organisations; the HPA, the National Travel Health Network and Centre (NaTHNaC), the Department of Health and the Foreign and Commonwealth Office (FCO), as well by international organisations such as the WHO. Close collaboration was essential to ensure consistent messages were being conveyed.

In addition to information on the website, telephone queries from health care professionals and the media resulted in considerable demands on HPA staff time. During the peak period, approximately sixty telephone calls per day were received by the CFI which required public health advice; many more calls were made to the press office, and to regional and local centres. Management of the response process was challenging in ensuring that staffing was adequate and that all team members were kept up to date with current information. Regular team meetings at the beginning and end of each day were used to brief key staff and allocate tasks.

Surge capacity within the HPA

The Health Protection Agency was formed on 1 April 2003, almost one month after the WHO issued the global alert on 12 March 2003. All Divisions of the HPA were involved in the response to the first global outbreak. The level of response required was

considerable given the challenges to the resources of the new organisation, where areas of responsibility and lines of communication were still being developed.

Day-to-day operational response to the evolving outbreak involved epidemiologists who undertook strategic planning and response tasks in addition to their normal responsibilities; administrative support was largely provided on an ad hoc basis, which resulted in some lack of continuity. Particular areas of shortfall during the outbreak period included continuity of staff, especially experienced medical and non-medical epidemiologists, and lack of a centralised operations centre to facilitate sharing of epidemiological and virological information during the investigation of potential cases. These issues were addressed in the short term by utilising experienced staff undergoing higher medical training (e.g. Specialist Registrars), and by seconding a medical epidemiologist to the CFI's Respiratory Department.

CFI has responded to national and international infectious disease incidents for many years, primarily through the redeployment of staff working within other areas of the organisation, as outlined in its Major Outbreak and Incident Plan. The HPA Strategic Emergency Response Plan also makes provision to redeploy staff and operate shift working to provide round the clock cover.¹² Staff redeployment is likely to become easier to achieve politically as the level of escalation increases and the pressures become more widely acknowledged both within and outwith the organisation.

There is currently limited surge capacity to respond to an incident such as SARS that requires a large team over a prolonged period of time to prevent fatigue and potential burn-out of key staff involved in the response. Future re-emergence of SARS, or any other newly emergent infection would lead to the prompt escalation of surveillance activities, with corresponding demands on staffing and resources.

Contingency planning

The emergence of SARS illustrated the need to strike a balance between mounting a multi-agency outbreak response and ensuring NHS and partner organisations maintain continuity of key services. Similarities noted with the planning requirements for an Influenza pandemic and those of a phased escalation of response to SARS were recognised, developed and exercised.¹³ This set out specified actions at local, regional and national levels for the HPA at each level of escalation dependant upon

the extent of disease transmission abroad and in the UK. The HPA SARS Contingency Plan also complemented activities specified by the Department of Health for the NHS.¹⁴

Implementation of the phased contingency plan response raised a number of issues regarding NHS acute and primary care trust (PCT) preparedness. The most notable of these concerned the purchase and supply of personal protective equipment (PPE) consumable items such as masks, gowns and respirators, as clear lines of responsibility were difficult to identify. Implementation of infection control guidelines, including appropriate staff training were also highlighted as areas of concern.

Conclusions

SARS demonstrated the speed with which a readily transmissible disease could spread around the world during the 21st century, resulting in considerable social, economic and political impact in some countries. International collaboration was fundamental to the rapid identification of the causative agent, and also to the containment of SARS.

Despite the UK being assessed as low risk from SARS throughout the first global outbreak the public health response was substantial and provided many challenges. It has provided the opportunity to test many mechanisms already in place so that they will

be further strengthened for the future. It has also prompted the drafting of detailed plans to respond to the re-emergence of SARS, or any other newly emergent infectious disease threat based on the lessons learned.

Both national and international collaboration proved vital in sharing timely information to inform the UK public health response. The use of electronic communication and teleconferencing was particularly effective in eliciting prompt responses from organisations and facilitating communication between expert groups (e.g. infection control and infectious disease experts) without the need to meet face-to-face frequently. The model has been utilised subsequently for assessing the threat to the UK of avian influenza and is due to be adopted more formally as a component of the UK response to future threats.

Data from countries with substantial outbreaks demonstrated that basic public health and infection control measures such as contact tracing, infection control procedures, quarantine and voluntary home isolation were effective in controlling the outbreaks in the absence of a rapid diagnostic test, a vaccine or effective treatment. The outbreak highlighted that all levels of the healthcare system in the UK need to be prepared to respond; especially as the level of threat remains ever present in light of the continuing widespread avian influenza outbreaks in south east Asia, and the potential emergence of a strain of the influenza virus with pandemic potential.

Key points

1. The prompt sharing of epidemiological and virological data through international collaboration was fundamental to understanding this newly emergent infection and informing the UK public health response, and underpinned an early recognition of the importance of 'real time' clinical epidemiology and the need for rapid liaison between clinicians, virologists and public health colleagues.
2. The formation of a National (UK) SARS Task Force contributed to consistent approaches to professional and public information and advice across the UK, particularly on the use of case definitions and management algorithms.
3. Flexible case reporting mechanisms need to be implemented at central, regional and local level during an evolving outbreak to inform appropriate public health measures.
4. SARS demonstrated the need for an integrated system of surveillance information, laboratory data and local public health response data, including contact tracing, to enable coordination and strengthening of the response across the UK.
5. Dissemination of timely guidance and advice during an evolving outbreak is crucial and requires close collaboration of key organisations to ensure regular and consistent situation updates.
6. A prolonged level of response to an incident such as SARS requires adequate surge capacity. This is being addressed through the development of an HPA Strategic Emergency Response, and contingency plans.
7. The rapidly evolving understanding of the diagnosis, clinical management and transmission of SARS underlined the importance of having explicit planning assumptions upon which critical control points of escalation of response within contingency plans were based.

The ability to respond to any large outbreak in the UK requires substantial surge capacity to develop guidelines, establish robust reporting mechanisms, follow-up large numbers of contacts, respond to enquiries from health care professionals and the public, and to undertake risk assessment. The development of comprehensive contingency plans, clearly outlining the roles and responsibilities of key players has been undertaken at all levels within the UK, from the Health Departments through to NHS acute and primary care trusts in the light of SARS.

National surveillance, such as that undertaken by the HPA, is essential for monitoring the spread of an infection, however, the vigilance of primary health care professions is crucial in the early warning response. The UK was spared by not experiencing a substantial outbreak of SARS. Nonetheless, valuable lessons have been learnt which will ensure that it is better prepared in the event of future public health threats.

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