Risk Assessment Framework for Severe Acute Respiratory Syndrome

Dana Sirbu, Monica Popa, Daniela Curseu, Ovidiu Ghiran and Adriana Manciu

Abstract - Severe acute respiratory syndrome (SARS) is a newly identified acute viral respiratory syndrome caused by the SARS coronavirus (SARS-CoV) which is believed to have crossed the species barrier recently from animals to humans. There has been one major epidemic to date, between November 2002 and July 2003, with 8,096 known cases of the disease, and 774 deaths (a mortality rate of 9.6%). This epidemic was characterized by "super spreading events" which seeded outbreaks in Canada, the People’s Republic of China, the Hong Kong Special Administrative Region of China, Taiwan, China, Singapore and Viet Nam. It remains very difficult to predict when or whether SARS will re-emerge in epidemic form. If SARS does recur, early detection of infected individuals will be crucial to contain the spread of infection and prevent international spread. The aim of this paper is to set out a framework of activities that can be used to assess the risk that SARS might recur and to prepare appropriate contingency plans.

Keywords: SARS, risk assessment, outbreak

1. INTRODUCTION

First identified in Guangdong Province in Southern China, Severe Acute Respiratory Syndrome (SARS) quickly garnered international attention because of its severity and seeming ease of transmission. By July 2003, the international spread of SARS-CoV resulted in 8098 SARS cases in 26 countries, with 774 deaths [1]. Countries with the greatest number of cases are China, Hong King, Taiwan, Canada, Singapore, and Vietnam. Since July 2003, there have been four occasions when SARS has reappeared. Three of these incidents were attributed to breaches in laboratory biosafety and resulted in one or more cases of SARS (Singapore, Taipei and Beijing). Fortunately only one of these incidents resulted in secondary transmission outside of the laboratory. The most recent incident was a cluster of nine cases, one of whom died, in three generations of transmission affecting family and hospital contacts of a laboratory worker [2]. These events demonstrate that the resurgence of SARS leading to an outbreak remains a distinct possibility and does not allow for complacency.

1.1. The Etiologic Agent

The SARS coronavirus (SARS-CoV) [3] is believed to be an animal virus that crossed the species barrier to humans recently when ecological changes or changes in human behavior increased opportunities for human exposure to the virus and virus adaptation, enabling human-to-human transmission [4]. Prior to the outbreak of SARS-CoV in 2002, two human coronaviruses (HCoV-229E and HCoV-OC43)–responsible for causing 15-30% of common colds–had been discovered. In addition to the two human coronaviruses, there exist several animal coronaviruses for which multiple vaccines have been developed and tested.

1.2. Stability and Resistance of the SARS Coronavirus

Virus is stable in faeces and urine at room temperature for at least 1-2 days. Virus is stable for up to 4 days in stool from patients with diarrhea because of its higher pH compared to normal stool. Virus loses infectivity after exposure to different commonly used disinfectants and fixatives. Heat at 56°C rapidly kills approximately 10 000 units of SARS-CoV per 15 minutes [5].

1.3. Clinical Features

SARS is a condition associated with substantial morbidity and mortality. The case-fatality ratio of SARS is estimated to range from 0% to more than 50% depending on the age group affected, with an overall CFR estimate of approximately 15%.

Most countries reported a mean incubation period of 4-6 days. Initial symptoms are flu-like and may include: fever, myalgia, lethargy, gastrointestinal symptoms, cough, sore throat and other non-specific symptoms. The only symptom that is common to all patients appears to be a fever above 38 °C. Shortness of breath may occur later. About 10–20% of cases require mechanical ventilation [1].

1.4. Routes of Transmission and Risk Factors

The primary mode of transmission appears to be direct mucous membrane (eyes, nose, and mouth) contact with infectious respiratory droplets and/or through exposure to fomites. The role of faecal-oral transmission is unknown; however, there is no current evidence that this mode of
transmission plays a key role in the transmission of SARS though caution was expressed on this point because of the lack of surveys and transmission studies among children where this is a common mode of transmission of other viral infection.

Potential high risk populations are the persons: age 40 or older, especially those over 65, which have other medical conditions (heart/ liver disease) and hospital workers or family members or victims. The main factors that determine the future path of any disease in a group are the size of the group, the number of people initially infected, the average number of daily contacts, the percentage of those contacts that result in transmission, and the recovery and mortality rates of the disease.

Risk factors for SARS were described in a number of studies. Health care workers, especially those involved in procedures generating aerosols, account for 21% of all cases, ranging from 3% of reported probable cases in the United States of America (1/33 cases) to 43% in Canada (108/251 cases) [6]. Other risk factors include household contact with a probable case of SARS, increasing age, male sex and the presence of co-morbidities. The care and slaughter of wildlife for human consumption in the wet markets of southern China is associated with serological evidence of infection [7].

1.5. Stages that Might be Seen in a SARS Outbreak

<table>
<thead>
<tr>
<th>Phase</th>
<th>Epidemiological situation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 0</td>
<td>No evidence of SARS-CoV transmission to humans worldwide.</td>
</tr>
<tr>
<td>Phase 1</td>
<td>Sporadic case(s) of SARS or a common source of transmission that does not result in secondary cases.</td>
</tr>
<tr>
<td>Phase 2</td>
<td>Confirmed human-to-human transmission.</td>
</tr>
<tr>
<td>Level 1</td>
<td>Chain(s) of transmission in one location.</td>
</tr>
<tr>
<td>Level 2</td>
<td>Chains of transmission in two or more locations but with no evidence of international spread.</td>
</tr>
<tr>
<td>Phase 3</td>
<td>International spread.</td>
</tr>
<tr>
<td>Phase 4</td>
<td>Slowing down of the outbreak.</td>
</tr>
<tr>
<td>Phase 5</td>
<td>Global interruption of SARS-CoV transmission (epidemic halted).</td>
</tr>
</tbody>
</table>

2. RISK ASSESSMENT FRAMEWORK

The responsibility for managing the risk of SARS re-emergence or introduction rests primarily with national authorities. WHO strongly recommends that all countries undertake a risk assessment as the basis for contingency plans, as SARS-related risks will vary considerably both within and between countries [8]. The framework is organized according to six phases, moving from the inter-epidemic period, when preparedness planning and routine surveillance for cases are stressed, through the establishment of chains of transmission and subsequent international spread, to global interruption of transmission.

These activities serve as a useful tool for formulating contingency plans that are adequately protective and appropriate to the level of risk. In this framework, the phase refers to stages that might be seen in a SARS outbreak.

2.1. Step 1 for Phase O – Inter-Epidemic Period

In order to assess the level of risk from the re-emergence of SARS-like coronaviruses, three possible situations must take into account:

- Emergence of SARS-CoV-like viruses from wildlife or other animal reservoirs – for those countries/areas which are identified as source(s) of the epidemic or areas with an increased likelihood of animal-to-human transmission of SARS-CoV-like viruses from wildlife or other animal reservoirs. In this moment this situation doesn’t exist in our country.

- Emergence or introduction of SARS-CoV from laboratories or through international travel.

- Low risk of SARS-CoV emergence or introduction for those countries/areas that never reported cases or reported only imported cases during the epidemic periods, and that do not conduct research using live SARS-CoV-like viruses or store clinical samples from SARS cases.

National health authorities should report the first "preliminary positive" case(s) of SARS to WHO within 24 hours of the receipt of positive test results from their national SARS reference laboratory. In the inter-epidemic period, all countries must remain vigilant for the recurrence of SARS and maintain their capacity to detect and respond to the re-emergence of SARS should it occur [9]. At the national level, in this period, the range of activities will vary depending on the risk assessment (table 2 and 3).

<table>
<thead>
<tr>
<th>Alert, verification and response activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Strengthen training in field epidemiology and promote linkages with the relevant disciplines responsible for clinical epidemiology, hospital infection control, laboratory biosafety, animal health and environmental health.</td>
</tr>
<tr>
<td>- Develop standard operating procedures for the investigation, clinical and public health management of patients with ARI with fever based on the national risk assessment for SARS and the local burden of respiratory disease.</td>
</tr>
<tr>
<td>- Report high-risk individuals or clusters under investigation for SARS to WHO promptly and transparently.</td>
</tr>
</tbody>
</table>
Table 3. Preparedness planning

2. Planning
- Undertake a national risk assessment for SARS-CoV
- Establish an effective SARS response management process at all levels of government and define the chain of command by assigning specific roles and responsibilities to key agencies (public health, curative and diagnostic services) for the investigation, verification, clinical and public health management of SARS.
- Review surveillance and reporting systems for SARS and other epidemic-prone diseases.
- Establish an inventory of all safety laboratories working with live SARS-CoV and SARS-CoV-like viruses
- Develop a communication strategy to provide accurate information to the public on risks to health from SARS-CoV, its presenting features, risk factors for exposure, clinical and public health management and preventive measures, including respiratory and contact precautions.

2.2. Phase 1 with Sporadic Cases of SARS

It will be activated the national response mechanism (national health authority or National SARS Taskforce or Technical Advisory Committee) to coordinate local and national response activities, such as:
- mobilize a multi-disciplinary team to investigate the transmission event.
- ensure that protocols and procedures for the containment, investigation, clinical and public health management of the case(s) and their contacts are implemented.
- initiate active case finding and serological studies for additional cases if warranted by the findings of the epidemiological investigation
- enhance passive surveillance for SARS in areas reporting recent local transmission

2.3. Phase 2

Level 1:
- Expand active case finding in the area reporting SARS to exclude the possibility of missed chains of transmission or transmission beyond two generations of cases.
- Enhance passive surveillance for SARS in areas within the country presumed free of SARS.

Level 2:
- Implement active case finding by lowering the threshold for SARS-CoV testing for acute respiratory illnesses, generally and febrile illnesses in high risk individuals.
- Raise public awareness of respiratory hygiene (hand washing, covering nose and mouth when coughing or sneezing) and appropriate health-seeking behavior if unwell with a fever and/or cough illness.
- If a safe and effective vaccine is available, consider ring vaccination of high-risk individuals

2.4. Phase 3
- Review containment and control practices if there are evidence of continuing transmission in particular individuals or segments of the population.
- Communicate in a timely manner, new knowledge indicating changes in the epidemiology, clinical features, clinical response or efficacy of public health measures that indicate the need for new approaches to containment and control.

2.5. Phase 4
- Enhance surveillance and follow up of SARS cases and persons under investigation as the local epidemic wanes. The aim of surveillance activities in this phase is to demonstrate a sustained fall in the number of new cases once control measures are implemented and a sustained reduction in the proportion of cases in which the source of exposure is unknown.
- Fully investigate persons with clinical evidence of SARS in whom the source of exposure is unknown to either confirm the diagnosis or confidently discard the case. The latter will require late convalescent phase serology.
- Increase laboratory testing as the epidemic wanes to detect diagnostic confusion with other causes of acute respiratory illness.

2.6. Phase 5
Step down to Phase 0 following a national assessment of the risk of unrecognized SARS-CoV transmission based on the WHO criteria above, unless SARS-CoV has become endemic in the human population.

3. Conclusions

Risk managers need to realize that the recent SARS scenario will likely be repeated in the coming years. The best approach to minimizing effects of the virus on humans should involve a SARS surveillance system to monitor the geographic and temporal spread of the virus over the world, to further develop national public health strategies for surveillance, prevention, and control, to develop a more complete regional picture of the geographic distribution and incidence of similar viruses, and to provide national and regional information to public health officials, elected government officials, and the public.

4. Acknowledgements
This study was undertaken as a part of the CEEX project - “SIMONPAN” 128/2006.

4. References


