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COVID-19: management and infection control

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Abstract
The coronavirus disease 2019 (COVID-19) pandemic has caused more than 4.5 million deaths worldwide to date. The emergence of the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has created immense pressure on health services and complex challenges in public health. Essential features in managing COVID-19 include best-practice care for the individual but also minimizing exposure to uninfected patients, staff and the wider community. The central tenets in limiting disease transmission involves strict infection and prevention control, categorizing COVID-19 cases as possible, probable or confirmed, alongside contact tracing, isolation, hand hygiene and droplet precautions.

Keywords COVID-19; infection and prevention control; public health; SARS-CoV-2; vaccines

Introduction
Coronavirus disease 2019 (COVID-19) has caused more than 4.5 million deaths worldwide to date. It is a multisystem, primarily respiratory disease caused by the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Risk factors for severe disease include increasing age, diabetes, hypertension, cardiovascular disease, male gender and obesity.1

Pathogenesis
SARS-CoV-2 is an enveloped virus coated with membrane proteins and spike glycoproteins. The spike protein is responsible for host cell binding and cell entry via angiotensin-converting enzyme 2 (ACE2) receptors. The incubation period is approximately 5–6 days but can be up to 14 days. SARS-CoV-2 viral load peaks within the first week of illness, around 1–2 days before symptom onset. SARS-CoV-2 antibody concentrations are usually detectable by day 14. Virus yield in culture approaches zero at 10 days after symptom onset in mild cases.2

Clinical features
Initial symptoms during viral replication include fever, dry cough, dysgeusia, anosmia, myalgia, headache and diarrhoea. By day 10–14, as viral replication declines, the host inflammatory response phase predominate and a proportion of patients develop pneumonitis, presenting with tachypnoea, hypoxia, pyrexia and fine end-expiratory bi-basal crackles, 10–15% developing severe illness with elevated inflammatory markers, progressive interstitial inflammation and multiorgan involvement. Be wary of ‘silent hypoxia’, a phenomenon where patients feel clinically well with disproportionately low oxygen saturations (SpO2); this is usually a ‘red flag’ for impending acute respiratory failure.

Management
Management in the community
Asymptomatic or mild disease (80% of cases) may be managed at home with simple analgesia. Individuals should be advised on symptoms of worsening disease and when to seek clinical advice; the use of pulse oximeters in the community has been useful in recognizing moderate-to-severe disease.1

Management in hospital
Severe disease is defined as having clinical signs of pneumonitis plus one of the following: >30 breaths per minute, severe respiratory distress or an SpO2 <90% on room air. These individuals require hospital admission. In addition to a nasopharyngeal SARS-CoV-2 polymerase chain reaction (PCR) test, recommended baseline investigations include a full blood count, metabolic panel, inflammatory markers including C-reactive protein (CRP), ferritin, lactate dehydrogenase, cardiac biomarkers, d-dimer, prothrombin time and arterial blood gas. Blood/sputum cultures and serum procalcitonin may identify bacterial co-infection. A chest X-ray should be performed to look for unilateral or bilateral infiltrates, seen in 25% and 75% of cases, respectively (Figure 1).1

Supportive treatment
Supplemental oxygen should be used to maintain an SpO2 of 92–95%. Awake prone positioning increases recruitment of alveoli and may improve oxygenation in patients with increasing oxygen requirements. Intravenous fluids may be required to maintain euvolaemia. Venous thromboembolism prophylaxis is recommended; enhanced prophylaxis or treatment dose low molecular weight heparin may be considered because of the increased risk of thrombosis.2 Antibiotics are only indicated for suspected bacterial co-infection based on features such as a productive cough, neutrophilia or radiological findings.1

Key points
- Coronavirus disease 2019 (COVID-19) is caused by the RNA-virus severe acute respiratory syndrome coronavirus 2
- It is a multisystem disease with a wide spectrum of disease severity from asymptomatic to critically unwell
- Treatment includes both supportive treatments and targeted treatments such as dexamethasone and tocilizumab
- Infection and prevention control measures including strict hand hygiene and facial coverings, and social distancing measures remain instrumental in preventing transmission

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Targeted treatment
Targeted treatment for COVID-19 is offered to all hospitalized patients requiring oxygen. Dexamethasone was associated with an 18% reduction in mortality in the RECOVERY (Randomized Evaluation of COVID-19 Therapy) trial (36% in those invasively ventilated). Tocilizumab demonstrated a mortality benefit and is offered, in addition to steroids, to those with a CRP >75 mg/litre and no evidence of bacterial co-infection. The RECOVERY trial also demonstrated morbidity and mortality benefits with the use of the monoclonal antibody combination casirivimab (1.2g)/imdevimab (1.2g) when used in seronegative patients with a history of immunocompromise and in early disease. Remdesivir, an antiviral agent, may shorten recovery time if provided within 10 days of symptom onset.

Ceiling of care
All admissions should have a frailty assessment (using the Clinical Frailty Score (CFS) if >65 years and a treatment escalation plan should be discussed. Studies in COVID-19 demonstrate a 12% increase in mortality for every 1-point increase in CFS. Outcomes of cardiopulmonary arrest in COVID-19 are poor with one study demonstrating only 7% of patients survived to 29 days with normal or mildly impaired neurological status (decreasing to 3% in those aged ≥80 years).

Critical care
Referral to critical care is required when a patient is approaching maximal ward-based care, i.e. is unable to maintain ≥92% SpO2 on a 240–60% fraction of inspired oxygen (FiO2), or have a respiratory rate >30 per minute, a systolic blood pressure <90 mmHg or a decreased level of consciousness. Non-invasive ventilation such as bi-level positive airway pressure, continuous positive airway pressure or high-flow-oxygen can be provided on medical wards that have appropriately trained staff. Mechanical ventilation requires monitoring on an intensive care unit. Extracorporeal membrane oxygenation has also been successfully used, but access is limited to specialist centres.

Figure 1 Chest X-ray features of severe COVID-19: bilateral multifocal lung changes with ground-glass opacification.

Figure 2 Treatment strategy for COVID-19. CPAP, continuous positive airway pressure; HFN0, high-flow nasal oxygen. Source: Image in the figure is reproduced from Centers for Disease Control and Prevention (CDC).
Extrapulmonary complications

Extrapulmonary complications are frequent and include pro-thrombotic, renal, liver, cardiovascular and neurological insults, and arrhythmias. These appear to be caused by a combination of endothelial injury via direct virus invasion into endothelial cells and increases in prothrombotic factors. Pulmonary emboli are common in patients with severe disease so a high index of suspicion, the use of imaging and therapeutic anticoagulation are critical (Figure 2).

Vaccines

SARS-CoV-2 mRNA vaccines such as Pfizer/Moderna contain mRNA segments coding for the spike protein, combined with a lipoprotein that facilitates uptake into cells. The Oxford AstraZeneca vaccine uses chimpanzee adenovirus DNA as a viral vector, engineered to contain code for the spike protein and, unlike mRNA vaccines, can be stored using standard refrigeration. All vaccines convey up to 95% protection against progression to severe COVID-19. Research determining whether variants are associated with decreased immunogenicity is continuing.

Infection control

Defining cases

Possible cases are defined as any person with one or more of the following: fever, cough, dyspnoea, new anosmia or dysgeusia.

Probable cases are individuals with radiological evidence compatible with COVID-19 or a possible case who has been residing/working in an area with high transmission rates of COVID-19 or had close contact with a confirmed case in the 14 days before symptom onset.

Confirmed cases are those with a confirmed PCR test.

Contacts are individuals who have been directly in contact with a confirmed case (within one metre of someone infected with SARS-CoV-2 for at least 15 minutes), regardless of whether they were symptomatic at the time.

Self-isolation and quarantine

Current guidance for patients with confirmed symptomatic or asymptomatic SARS-CoV-2 in the community is self-isolation for 10 days (symptoms must have resolved for 24 hours before completing isolation). Unvaccinated contacts of a confirmed case must quarantine for 10 days and undergo testing if they become symptomatic. Individuals admitted to hospital require 14 days’ isolation.

In hospital, confirmed, possible or probable cases and those awaiting PCR test results should be isolated with similar cases or in side rooms. Outbreaks in healthcare settings are challenging and require strict contact tracing, isolation measures and regular outbreak control meetings.

Hand hygiene and droplet precautions

Infection control measures are as per any droplet spread infectious disease. Strict hand hygiene, use of gloves, aprons, and surgical masks covering the chin, mouth and nose, physical distancing and keeping areas well ventilated are essential in preventing viral transmission. In an environment with aerosol-generating procedures such as invasive or non-invasive ventilation, more specific respiratory precautions should be taken, including FFP3 masks.

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