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The Intensive Care Professionals

Caring for Critically Ill Patients with Novel Coronavirus

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As of January 30, 2020, 14 countries have confirmed cases of the 2019 novel coronavirus (2019-nCoV), and the number of cases has almost tripled.[1]

Many of us have gone through the process of preparing for serious outbreaks, and some have been in the unfortunate situation of responding to them. It seems that each new outbreak brings a level of chaotic activity rather than implementation of a set of strategies and operational tactics.

Concern over the 2019 novel coronavirus (2019-nCoV) is growing. It is vital that those on the frontlines be prepared. This article highlights several strategic goals and special considerations related to caring for a critically ill patient who can transmit a deadly disease to you, your staff, or others in your hospital.

Many of the shortfalls in previous responses have occurred in hospitals. The disconnect has generally been in marrying infection control guidance with the myriad clinical activities necessary to care for a critically ill infected patient.

Why should we pay attention to an outbreak that seems small and is in other regions?

Human-to-human transmission of a potentially deadly pathogen, even in small numbers relative to the population health burden of other critical illnesses, is an existential threat to even the most sophisticated facilities, as was demonstrated by the severe acute respiratory syndrome (SARS) outbreak of 2002-2004.

Despite the limited relative burden of disease compared to everyday conditions, it is crucial that we protect our hospitals from unrecognized exposure, since such an event can devastate an entire hospital and community. Emergency departments (EDs) and critical care units are major locations for disease transmission for both healthcare workers and patients. A 21-hour period of unprotected exposure in the first impacted hospital in Toronto ultimately led to 128 nosocomial cases in this facility and sparked additional transmission in two other hospitals due to transfers of two critically ill patients with unrecognized disease.[2]

The challenges of caring for a relatively small number of patients (375 confirmed and suspected cases in Ontario) resulted in the cumulative closure of nearly one-third of Toronto's critical care beds during the

response.[3] About 37% of the secondary cases at the initial hospital were healthcare workers, 14% were hospitalized patients, and 14% were hospital visitors.[4] This facility closed to new admissions, closed its outpatient clinics, and quarantined its discharge patients to gain control of the outbreak. SARS ultimately led to more than 8,000 cases and 800 deaths.

The importation of a case of MERS-CoV to South Korea led to similar outcomes. A businessperson who traveled to several Middle Eastern countries and then back to Seoul sought treatment in multiple hospitals, leading to more than 180 cases and 30 deaths.[4]

Both the Toronto and Seoul initial cases occurred at a time when no cases had been identified in their respective countries. However, even when risk perception is high, countering disease transmission in modern hospitals is very difficult. In 2014, an outbreak of 255 MERS-CoV cases led to 93 deaths in Jeddah, Saudi Arabia. An investigation suggested that the event was a result of human-to-human transmission in healthcare facilities, rather than an uptick in primary cases in the community, despite MERS-CoV already being endemic in the country and region.[5]

What are the initial strategic steps in preparing to care for patients who are ill from 2019-nCoV infection?

Clinical facility leaders must define and disseminate strategic goals and use the best available science to develop risk-based objectives and tactics.

Strategic Goals:

1. **All patients infected with 2019-nCoV must be identified immediately and isolated prior to causing unrecognized, unprotected exposure.**
2. **Transmission of 2019-nCoV to other patients, visitors, and healthcare workers must be a never event.**
3. **Critically ill patients infected with 2019-nCoV must receive the best possible care without putting healthcare workers at unacceptable risk.**

The availability of rapid diagnostic tests is one of the most effective ways to achieve the first strategic goal. Currently there are insufficient primers to allow testing for 2019-nCoV even at the state level, so hospital-based respiratory testing (for bacterial and viral pathogens) should be considered to search for other etiologies. While coinfection is plausible, infectious disease experts, in collaboration with intensivists, should consider using currently available respiratory panels to find other causes and rule out 2019-nCoV in low-risk patients.

Hospitals and outpatient clinics are complex organizations with large numbers of clinical, administrative, and support staff who are essential to the best preparation and response, but there are significant challenges to operationalizing collaboration. Leaders must ensure inclusivity and transparency. Fear and mistrust can occur when staff believe they are being put in harm's way without appropriate support and guidance. The knowledgebase and science of the outbreak are rapidly evolving. Leaders must convey what they know, what they do not know, what they are going to do, and how they are going to reevaluate to ensure the best possible approach."

Before an infected, symptomatic patient receives care in your hospital, tremendous attention must be paid to the first strategic goal, which is challenged by the breadth and volume of everyday healthcare needs, clinical workflow, and limited infrastructure resources to offer the highest level of environmental

control (eg, airborne infection isolation) at every possible clinical site. While many details about 2019-nCoV transmission remain unknown, transmission of SARS and MERS-CoV can offer some guidance on how to approach immediate identification and isolation of potentially infected patients who are interfacing with healthcare facilities.[4,6]

In general, higher transmission (by super-spreaders) in these related diseases has occurred in early generations of human-to-human transmission and by people who are quite ill. While asymptomatic transmission has not been definitively disproven, it is at most a limited source of spread.

So, initial preparedness activities must ensure high reliability of recognition, isolation, and use of appropriate personal protective equipment (PPE) in high-risk areas such as EDs and critical care units, especially those that accept transfers from other hospital. Medical units that commonly treat community-associated respiratory conditions should also implement these practices. This is not to say that lower-risk areas should be ignored, but initial activities for high-risk areas should be prioritized rather than trying to maintain the same level of capability at every entry point.

Lower-acuity areas such as ambulatory clinics should still actively prepare. But unless a patient is clearly ill enough to be hospitalized, simple tactics—such as rigorous adherence to droplet and contact isolation—together with distancing clinicians from extremely close contact (eg, by use of electronic communication devices to ascertain history and symptomatology) are likely to be sufficient initially.

Public health officials must provide guidance on whether testing can be performed in an ambulatory care setting and when isolation in the community is needed. If a patient needs to be transferred to an ED, emergency medical services and the receiving ED must obtain appropriate notification to allow for choreographed transfer of the patient.

Often though there is a gap between public health messaging and effective hospital operational implementation. The initial messaging usually provides a case definition, which is useful for epidemiologic investigations, but the utility in clinical practice when trying to provide care in a busy outpatient practice or ED where many patients have similar overlapping clinical signs and symptoms may be less than optimal.

The key to case finding is the epidemiologic link to high-risk exposure. Clinicians should ask their patients about travel and what they did while traveling.

SARS and MERS-CoV also taught us that most high-risk people without a travel link were closely associated with someone who had traveled or were healthcare workers. Clinicians may choose to broaden questions to ask about family members' or close associates' travel and illness as well as potential occupational exposures (eg, clinicians caring for patients with severe respiratory infections).

Clinicians must also be suspicious when a patient without usual risk factors presents with a severe respiratory syndrome. While we all see young, previously healthy people occasionally present with severe, even catastrophic, illnesses, we should consider isolating until we have an alternative. The dilemma is that we usually do not have rapid diagnostics to clarify whether a patient has a highly infectious case.

Unfortunately, the epidemiologic link is not foolproof. In Hong Kong, a traveling physician staying at a hotel transmitted SARS to a number of international visitors who subsequently imported the virus back

to their home countries. Still, increasing clinicians' attention to the epidemiologic link is likely to dramatically reduce the chances of unrecognized exposures within their facilities.

How do we care for a patient with suspected or confirmed 2019-nCoV?

The second and third strategic goals are integrally linked to how well clinicians and clinical workflow are incorporated into the response development.

ED and critical care clinical leaders (eg, nurses, clinicians, respiratory care therapists) should not be passive receivers of planning. They must be active participants to ensure that infection control recommendations marry with clinical practices and goals. Healthcare facilities must include clinicians in all preparedness planning and must consider any secondary transmission in their facility a major failure.

Blaming clinicians or other staff for failure to properly use PPE or adhere to infection control practices—unless due to deliberate malice—is not an acceptable approach. As high-performing facilities have transitioned to highly reliable organizations and implemented shared accountability programs, a similar approach must be taken around safeguarding against secondary transmission. Staff must be given the right tools, training, and engineered processes to successfully render care and prevent secondary transmission.

During a number of outbreaks, I have witnessed a lot of time and energy spent on decisions regarding which respiratory protection device to use and how to meet regulatory compliance. These decisions are of course important, but much of that effort should be spent ensuring clinician competency with use of the devices while delivering clinical care. For example, fit testing for N95 respirators is necessary but not sufficient. We must ensure that equipment is consistently worn correctly and that clinicians do not self-contaminate when doffing.

Simulation environments to recreate the workflow and stress of delivering time-sensitive clinical care and evaluating both knowledge and competency of PPE use should become a mainstay of training for staff in high-risk areas. Healthcare facilities must convert from simply buying and stockpiling PPE and fulfilling regulatory compliance issues to confirming that all appropriate staff have expertise in infection control practices and PPE.

Decisions regarding which PPE is used should be made within a multiprofessional group. Expertise in the advantages and disadvantages of different equipment should drive the decisions. When conflicting strategies arise, final decisions should rest with those who are willing to be in high-risk areas. The person who packs parachutes for a team jumps with the team.

Once a patient with suspected or confirmed 2019-nCoV is isolated and under care, all components of care must be dissected for staff safety and optimal patient outcomes. There were no specific therapies for SARS or MERS-CoV, but they did not cause death for most patients, even those who were critically ill. Hence, when it comes to providing advanced care to patients infected with 2019-nCoV, hospitals should determine which organ-supportive care they will provide and whether they will restrict any usual interventions. These decisions must include experts in these therapies.

For example, if a hospital provides venovenous extracorporeal membrane oxygenation for refractory respiratory failure, will the hospital be willing to do the same for patients with very severe respiratory

failure due to MERS-CoV infection? The likelihood that the patient will benefit significantly from the treatment should be considered, along with additional risks to staff and other patients. Whichever procedures are deemed to be within the scope of care for patients with 2019-nCoV, detailed planning must be undertaken by clinical experts in collaboration with facilities and infection control experts to ensure high levels of safety.

Some hospitals may have sufficient staffing and resources to employ a dedicated response team once a patient is suspected and isolated. All clinical staff need to be able to safely use PPE and rapidly identify and isolate a potential infected patient. Then the dedicated response team can provide all the specialized clinical care. The advantage is having fewer people to train to a very high level of competency. Disadvantages are the delay in care while the team is activating and the logistics needed to maintain an additional on-call team.

Whether or not a specialized team is employed, infection control and occupational safety experts should be deployed to clinical sites with infected patients to actively observe and ensure that practices are optimized for safety. Also, the care team should participate in multiprofessional huddles at least once each shift to discuss care goals and safety strategies and disseminate any new revisions in care practices. A culture of crew resource management should be employed to encourage all staff to practice safety and modify potentially unsafe opportunities.

In everyday clinical practice, most clinical decisions are made with attention only to the risks and benefits to a particular patient. However, during an outbreak, additional considerations regarding risk to staff and other patients may influence care decisions.

Practices such as timing of intubation, use of supplemental oxygen therapies such as noninvasive positive-pressure ventilation (NIPPV) and high-flow nasal cannula (HFNC), and performance of bronchoscopy may veer away from everyday standards. For example, emergent intubations have been linked to high-risk transmission events. Clinicians may determine it more prudent to intubate when a patient requires less than maximal supplemental oxygen support in order to provide a more controlled setting. This may lead to intubating a patient who might have been able to avoid mechanical ventilation, but it may reduce the risk of transmission due to more deliberately choreographed interventions. The hospital emergency management group within its incident command structure should have a subgroup that standardizes such decisions.

Clinical leaders should translate the second and third strategic goals into clinical tactics, especially when they differ from everyday use. If NIPPV and HFNC are deemed acceptable during the outbreak, should patients be allowed to be transported on these therapies to a higher level of care? How should filters in a variety of ventilator types and circuit configurations be used? When should disposable bronchoscopes be considered versus reusable bronchoscopes? Public health and infection control authorities provide excellent general guidance, but it is usually not specific enough to address all situations.

As we have learned from SARS, influenza A (H1N1)pdm09, MERS-CoV, and Ebola virus disease, much of the beneficial supportive care practices are similar to everyday critical care. However, occasionally features differ and require rapid communication to the critical care community. Mortality in acute respiratory distress syndrome (ARDS) is usually due to multiple organ dysfunction; only a limited number of cases are due to refractory hypoxemia.[7,8] During the 2009 influenza pandemic, refractory gas exchange abnormalities were more commonly associated with mortality and may explain the perceived benefit of therapies that traditionally demonstrated improvement in oxygenation but historically were

not confirmed to offer a survival advantage (younger patient ages may also have impacted the results).[9] Therefore, expanding the use of rescue therapies may have been beneficial and seemed to continue to be beneficial in subsequent seasons when the (H1N1)pdm09 strain predominated.

As some centers become experienced in caring for patients with 2019-nCoV, it is imperative that they share basic information, including features that help distinguish 2019-nCoV from everyday conditions, organ dysfunction and required support, response to therapy, duration of infectivity, and treatment strategies.

Critical care clinicians should use various methods (eg, conference calls, social media, webinars) to share information with colleagues at the local, regional, national, and international levels. Institutions with a clinical research infrastructure should collaborate with others to rapidly generate a knowledge base to improve care processes during the evolving outbreak. Infection control experts should perform transmission studies (beyond retrospective epidemiologic methods) to improve knowledge of how the virus is transmitted in varied clinical environments. Scientifically valid transmission information can better inform ways to protect our staff and patients as well as to reduce fear.

I wish you all safety, and hope this outbreak goes away soon.

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