Innovation and Knowledge Sharing Can Transform COVID-19 Infection Prevention Response

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Emerging studies on coronavirus disease 2019 (COVID-19) confirm high rates of infection among healthcare workers (HCWs).[1] As widespread community transmission increases, frontline HCWs, such as hospitalists, are at particularly high risk of exposure to people with undiagnosed COVID-19. Although there is no known effective treatment for COVID-19, early detection is vital to decreasing ongoing transmission through contact tracing and quarantine. However, lack of adequate testing capacity prevented basic public health interventions from curbing the pandemic at an earlier stage. As a result, given high rates of presumed community transmission of COVID-19 and evidence for asymptomatic transmission, there have been moves toward the use of universal personal protective equipment (PPE). This strategy is challenging to implement because of the acute PPE shortage, which has resulted in an urgent need to embrace innovation in infection prevention.

The current pandemic has resulted in an unprecedented volume of data being generated and disseminated, with the potential to impact real-time responses in geographically disparate regions. Here, we focus on the potential for innovation and knowledge sharing from an infection prevention perspective, which could enhance frontline HCW safety in the current COVID-19 pandemic.

DIAGNOSIS MATTERS

Every outbreak begins and ends with a diagnostic test. Widespread population testing coupled with intensive contact tracing had the potential to curb national epidemics if it had been implemented in time. In the United States, which now has the highest number of COVID-19 cases worldwide, there were technical difficulties with the first diagnostic test developed by the Centers for Disease Control and Prevention (CDC) and subsequent delays in scaling up access to COVID-19 diagnostic testing.[2] The strategy of initially reserving testing only for those who were critically ill meant that by the time patients with COVID-19 were being diagnosed, widespread community spread had occurred because of the lack of detection of individuals with less severe or asymptomatic infections.

In contrast, scaled-up testing in South Korea has helped limit the spread and consequences of COVID-19. The use of drive-through testing centers enabled safe and efficient testing, while minimizing the risk to HCWs and eliminating the possibility of cross infection among people being tested.[3] Although outdoor testing is not feasible in all settings, this approach avoids resources and time typically needed for ventilation (typically a negative pressure room with 12 air changes per hour would be used) and cleaning of specimen collection rooms.

The other major diagnostic gap is the ability to identify individuals who have recovered from COVID-19 and are immune. There is an urgent need to develop and scale up a rapid serological test that avoids cross-reactivity with other coronaviruses. Ideally, this test would permit testing of HCWs to determine who is likely immune and can therefore return safely to work.

RETHINKING PPE

There has been a massive and rapid increase in the need for PPE globally because of overwhelmed health systems having to care for large numbers of patients with suspected or confirmed COVID-19. This has been exacerbated by public fear, which has led to panic buying of medical face masks (primarily used to protect others from infections with a droplet mode of transmission) and filtering facepiece half-mask respirators, which include N95 respirators (used to protect the wearer from infections with an airborne mode of transmission).

COVID-19 is thought to be predominantly spread by transmission of respiratory droplets (>5 and <10 μm in diameter), which occurs when people are in close contact (within 1 meter) with others who typically (but not always) have respiratory symptoms such as cough or sneeze or with fomites that have come into contact with an infected person. This is in contrast to infectious diseases such as tuberculosis (TB) or measles, which are spread by airborne transmission of virus suspended in droplet nuclei (<5 μm in diameter), which can remain in the air for prolonged periods of time and can be transmitted over distances greater than 1 meter.[4]

While World Health Organization (WHO) and CDC infection prevention guidance have cited droplet transmission as the primary mode of transmission for COVID-19, current CDC guidelines state that respirators are preferred for the care of

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patients with known or suspected COVID-19, given the potential for opportunistic airborne transmission.[5] However, in the setting of respirator shortages, it is recommended that these should be prioritized for HCWs caring for patients with COVID-19 in the context of aerosol-generating procedures or other patients with infections spread by airborne transmission such as TB or varicella until the supply chain is restored. Of note, optimal use of respirators requires fit testing, which is often lacking in nursing homes and outpatient facilities, as well as more widely in resource-limited countries.

Universal masking (use of surgical mask) for HCWs caring for any patient irrespective of symptoms or presenting complaint has also been implemented by many large hospital systems in recent days. Although universal masking adds to the burden of the PPE shortage, in settings with widespread community transmission and given increasing evidence[6] demonstrating transmission from people with asymptomatic and presymptomatic infection, universal masking may be useful to decrease transmission. However, particularly in the setting of PPE shortages, it is important to understand that surgical masks are designed to be single use and that dampness and frequent adjustment of the mask affects their effectiveness.

As urgent attempts to coordinate and increase PPE manufacture are being made by health systems, in conjunction with private partnerships, there has also been a burst of public campaigns to sew cloth masks to mitigate the real-time shortages. Although it is likely that cloth masks provide inadequate protection in comparison with surgical masks,[7] evidence does suggest that cloth masks provide some degree of protection from the spread of respiratory viruses,[8] particularly if these are replaced promptly when damp or damaged and if combined with other interventions such as hand hygiene. This has led to recommendations for the general public in various countries to wear cloth face coverings in public settings, particularly where social distancing may be harder to maintain, but these are not recommended for use by HCWs in healthcare settings.

INNOVATION IN INFECTION PREVENTION

Strategies to navigate the PPE shortage in the era of COVID-19 include importing, reclaiming, reusing, and repurposing PPE; generating and extending supply; eliminating nonessential services; reducing patient contact; and using nonhuman services such as drones to deliver equipment and undertake tasks such as decontamination.[9,10] Multidisciplinary teams are working on creative ways to use existing resources to make effective PPE, including alternatives to N95 respirators. An outbreak simulation study at Emory University in Atlanta, Georgia, and the University of Texas Health Science Center at Houston in Texas demonstrated that HCWs could be rapidly trained and fit tested to use elastomeric half-mask respirators, which are reusable.[11] A multidisciplinary team at Boston Children's Hospital in Massachusetts has developed and completed a small pilot study of a reusable elastomeric respirator made using an anesthesia facemask, antimicrobial filter, and elastic straps.[12]

Given evidence that suggests that COVID-19 involves a component of airborne transmission,[13] in addition to droplet spread and surface (fomite) contamination,[14] using known infection prevention techniques that work to decrease airborne transmission of other respiratory infectious diseases should also be considered. Germicidal ultraviolet (GUV) air disinfection rapidly disinfects upper room air, which is then continually exchanged with contaminated lower-room air. GUV air disinfection has been demonstrated to be a safe and cost-effective intervention, with an efficacy of approximately 80% for decreasing TB transmission.[15] GUV air disinfection is also effective against airborne influenza and measles and may play a role in surface decontamination by accelerating viral inactivation. Enabling GUV in high-risk areas such as the emergency department or intensive care unit could be a high-yield intervention to decrease transmission of COVID-19.

HCWs exposed to other respiratory infections such as influenza or TB may receive preventive therapy to reduce the risk of developing disease. High rates of COVID-19 in HCWs have prompted several initiatives to evaluate innovative approaches to decreasing this risk. Multiple studies are underway to determine whether hydroxychloroquine could be used for pre- or postexposure prophylaxis to prevent COVID-19. Another multisite trial will evaluate whether the BCG vaccine, primarily used to reduce the risk of TB, provides protection against COVID-19 in HCWs, driven by data suggesting a correlation between universal BCG vaccination policy and reduced morbidity and mortality for COVID-19.[16]

DATA GENERATION AND KNOWLEDGE SHARING

Infection prevention efforts can benefit from the unprecedented amount of data on COVID-19 that is being generated and shared. Successful examples of the rapid intensification of infection prevention measures to decrease transmission in healthcare facilities should be emulated. The hospital authority of Hong Kong implemented a bundle of measures focused on early recognition, isolation, notification, and molecular diagnostics for people being evaluated for COVID-19.[17] They subsequently broadened the clinical and epidemiological criteria of surveillance as the outbreak evolved and intensified PPE recommendations to all HCWs (face masks for all and N95 respirators for those performing aerosol-generating procedures), which appears to have resulted in no cases of HCW infection or nosocomial transmission.

Data characterizing the extent of occupational infections in HCWs during acute and chronic epidemics is often lacking and subject to wide variability in reporting, which limits its impact. For example, HCWs in high TB incidence countries have at least twice the risk of developing TB, compared with the general population. Although there are still major gaps in national data collection regarding the incidence of occupational TB, recent attempts by WHO to systematically record this data have resulted in increasing prioritization of this group as an at-risk population who may benefit from TB preventive therapy. We strongly advocate that health systems systematically record and share longitudinal data on numbers of HCWs infected with COVID-19. This transparency will facilitate urgent action

to replenish and sustain resources such as PPE and enable institutions to share and adapt successful infection prevention strategies. Examples such as the prevention of central line-associated bloodstream infections demonstrate the potential impact of national collaborative efforts to strengthen infection prevention, although further effort is needed to optimize knowledge sharing in the context of outbreaks.

CONCLUSIONS

The cost of not investing in public health pandemic preparedness including measures to protect HCWs is now widely apparent. HCWs have a right to safety in their workplaces as they fulfil their duty of care to patients.[18] Rapid scale-up of diagnostic testing capacity, and bundles of infection prevention interventions including universal masking and drive-through testing, can safeguard HCWs and the patients they serve in the current COVID-19 pandemic. Re-establishing immediate access to quality-assured PPE is imperative to reduce the individual and workforce consequences of HCWs developing COVID-19 or other infectious diseases like TB that are continuously a threat to the workforce. Meanwhile, innovative approaches such as repurposing resources to develop PPE and use of GUV air disinfection may help to mitigate PPE shortages, and use of preventive therapies may also decrease COVID-19 risk in HCWs. Reliable surveillance data on HCW infection rates can help identify and track gaps in infection prevention, as well as identify strategies that impact this outcome. Ultimately greater top-down political commitment is urgently needed to ensure that frontline HCWs have the necessary resources to address the current pandemic and to sustain these interventions to protect HCWs in the future.

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