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COVID-19 crisis prompting innovation in addressing personal protective equipment shortage

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Abstract

Coronavirus disease 2019 (COVID-19) has swept across the globe overwhelming health care systems and disrupting supply chain of personal protective equipment (PPE) like gloves, surgical face masks, goggles, face shields, N95 respirators and gowns. Surging demand, panic buying, hoarding, and misuse of PPE has led to substantial jump in its demand. Despite the terrible impact of COVID-19, if there's any silver lining to this crisis, it is the rapidity at which communities are moving toward innovation in not just medicine and remote work but also in ways to mitigate the growing PPE shortages.

Keyword: Centres for Disease Control and Prevention (CDC), facemasks, personal protective equipment (PPE)

The world is battling coronavirus 2019 (COVID-19) pandemic, a human tragedy. It has overwhelmed health care system globally, and now has fatigued the global production capacity of personal protective equipment (PPE). Surging demand, panic buying, hoarding, and misuse of PPE has triggered dramatic rise in demand for gloves, surgical face masks, goggles, face shields, N95 respirators and gowns, prompting significant price gouging, production backlogs and disruption of supply chains worldwide.¹ Pandemics in the past have shaped human history, propelling public-health innovations. This contagion, like all other, has ignited a wave of innovation in approaching the ways to mitigate PPE deficit globally and locally.

In response to the pandemic, Centres for Disease Control and Prevention (CDC) has identified different levels of operational status to optimize the supply of face masks.²

In regular practice, facemasks should be used to protect against splashes and sprays when

exposures are anticipated, including surgical procedures.² Conserving resources by removing all facemasks from public areas, availing masks to symptomatic patients, emergency departments and implementing extended use is recommended by CDC during the periods of expected facemask shortages.² It is recommended by CDC to cancel nonemergency procedures, outpatient encounters and implement re-use of facemasks in the setting of known shortages.² When no facemasks are available, it recommends excluding clinicians at higher risk (old age, comorbidities, pregnant) and designating the ones who have recovered from infection to treat patients with COVID-19 infection. Homemade mask can be used if necessary.²

Global Innovations- To address the impending global PPE shortage, Journal of American Medical Association (JAMA) issued a call for creative solutions from health care professionals (HCPs) around the world, which has generated several inputs, Table 1.³

Table 1. Possible solutions for PPE conservation and management (adapted from³)

Possible solutions for PPE conservation and management
• Import from international suppliers
• Reclaim by public and private buybacks
• Reuse by disinfection
• Repurpose prefabricated devices (snorkel, scuba, sports eye protector, motorcycle helmets with visor)
• Reduce non-essential services
• Reduce patient contact
• Alter staffing
• Use of nonhuman services like drones, robots
• Employ immune workers
• Use government solutions
• Stratify use by risk profiling

An Israeli start-up developed washable masks embedded with antimicrobial agents that could prove more effective than disposable masks.⁴ Sterilization of N95 with ultraviolet irradiation inactivates coronaviruses, without adversely affecting their fit and filtration.⁵ Other agents ranging from ethylene oxide, gamma irradiation, ozone, and alcohol have been identified but uncertainty about the effects of these sterilizing agents on structural

integrity of PPE remain.⁵ Homemade masks made from t-shirts blocked approximately 50% of 0.02-1 micron particles, compared with up to 90% blocked by standard surgical masks.⁶ Both masks reduced the number of microorganisms expelled, but the surgical masks were two times more effective in blocking transmission than the homemade masks.⁶

Innovations to preserve PPE by minimizing human contact have been developed. For instance, an automatic mask vending machines is rolled out in Taiwan to abate the need for workforce.⁷ China and Spain have deployed drones to transport medical supplies like test kits between hospitals and to tell people to stay indoors. China has robots on the roads and subway system to detect people with fever. In hospital they help in monitoring infected patients, delivering medical supplies and disinfecting wards. Robots were also used for delivering groceries and pharmacies.⁸

There are also examples of how remote technologies are addressing challenges of PPE shortages. Contact-tracing technology using smart phones is being used in many countries to identify sick people, isolate them, and then identifying and quarantining people they came into contact with to break disease transmission chains.⁹ Telemedicine is being utilized for consultation as medical professionals need to stay disease-free and preserve PPE.¹⁰

Local innovations- Besides global evidences on managing PPE shortages, some ideas bred locally to address this issue is praiseworthy. Bheri Hospital in Nepalgunj is making gown from thin plastic, goggles from transparent stationery and helmet from elastic apparel material. Other hospitals in the region have adopted this design to manufacture gears in local garment factory.¹¹

Similarly, Mahabir Pun, a Nepali activist, has leveraged his social media account to call for tailors and garment shops to collaborate in mass production of protective gears.¹¹ To raise awareness about hygiene, All Nepal Football Association has released a video in which players address the population.¹² All these efforts lessen the use of gloves, face masks, goggles, face shields, N95 respirators and gowns.

My perspective- The initiatives from government and citizens provide critical assistance, but I think additional steps are

needed to ensure the handiness of protective gears. First, with no sign of pandemic coming to a close, I believe Nepal government should encourage local entrepreneurs to set up new production facilities for protective gears by offering them incentives because there is a global shortage and the demand will continue to escalate down the line. A national stockpile is needed to tackle future outbreaks or a potential second wave of COVID-19.

Second, hand washing remains one of the few weapons in the virus-killing arsenal and minimizing the need of PPE. I think, government should contract with local distilleries and companies in the nation to ramp up domestic production to distribute free soap and hand sanitizer.

Third, public use of masks helps prevent virus spread but a big public run on surgical masks could make an already critical unavailability of masks for doctors and nurses even worse. In my opinion, government should reinforce the CDC's guideline on using homemade masks like scarves and bandanas that cover entire front and sides of the face.

Fourth, telemedicine already in use in Nepal can be deployed to filter out potential COVID-19 cases remotely, assess the condition of infected people under isolation and provide remote consultations for non-COVID-19 patients, limiting the patient displacement to hospitals.

Conclusion

COVID-19 pandemic is an unprecedented crisis and several measures of innovations in public health areas have emerged.

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