

Customized personal protective equipment (PPE): Solution to conservation and management of supplies during the coronavirus disease 2019 (COVID-19) pandemic

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ABSTRACT

In the COVID-19 pandemic, global health care systems have become overwhelmed with potentially infectious patients seeking testing and care. Preventing spread of infection to and from health care workers (HCWs) and patients relies on effective use of personal protective equipment (PPE). The most critical part in due course of managing this pandemic is adequate supply of PPEs. We have customized a PPE which is economical and reusable after proper disinfection. This customized PPE can be a solution to conservation of supply during this pandemic.

Keywords: Personal, Protective, Equipment, PPE

The current outbreak of the novel coronavirus SARS CoV-2 (coronavirus disease 2019; previously 2019nCoV), epi-centered in Hubei Province of the People's Republic of China, has spread to many other countries. On January 30, 2020, the World Health Organization (WHO) Emergency Committee declared a global health emergency based on growing case notification rates at Chinese and international locations.

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As of April 5, 2020, the Ministry of Health and Family Welfare has confirmed a total of 3072 cases, 213 recoveries (including 1 migration) and 75 deaths in the country.^[1] Experts suggest that the number of infections could be a substantial underestimate, as India's testing rates are among the lowest in the world.^[2] The outbreak has been declared an epidemic in more than a dozen states and union territories, where provisions of the Epidemic Diseases Act, 1897 have been invoked, and educational institutions and many commercial establishments have been shut down. India has suspended all tourist visas, as a majority of

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the confirmed cases were linked to other countries. The WHO chief executive director of health emergencies program Michael Ryan said that India had “tremendous capacity” to deal with the coronavirus outbreak and, as the second-most populous country, will have an enormous impact on the world’s ability to deal with it.

The key to a response to a public health emergency lies in abundant reserves and proper allocation of emergency medical supplies, for timely supplies are crucial to reducing deaths and increasing the rate of successful treatment. An epidemic caused by a new pathogen can often deal a blow to the health system, resulting in a shortage of supplies and medicines. For example, the United States was faced with an outbreak of H1N1 influenza in 2009; many hospitals suffered from a shortage of personal protective equipment (PPE). The SARS-CoV-2 outbreak coincided with Chinese New Year, so most of the manufacturers and distributors were on holiday; this further intensified the shortage of medical protective supplies in combating the epidemic. Hospitals across the country, and especially those in Wuhan where the situation is the most severe, have cited a vast shortage of medical supplies, and especially personal protective supplies such as medical protective clothing and N95 masks; the hospitals are urgently calling for societal support.

Preventing the spread of infection to and from health care workers (HCWs) and patients relies on the effective use of PPE—gloves, face masks, air-purifying respirators, goggles, face shields, respirators, and gowns.^[3] A critical shortage of all of these is projected to develop or has already developed in areas of high demand. PPE, formerly ubiquitous and disposable in the hospital environment, is now a scarce and precious commodity in many locations when it is needed most to care for highly infectious patients. An increase in PPE supply in response to this new demand will require a large increase in PPE manufacturing, a process that will take time many health care systems do not have, given the rapid increase in ill COVID-19 patients.

The minutes of a meeting held by the Ministry of Textiles on March 18 noted that the Health Ministry would require more than 700,000 protective coveralls, 6 million N-95 masks, and 10 million 3-ply masks until the end of May. The estimates are wildly conservative in the eyes of industry watchdogs. According to the All India Drug Action Network, the need for coveralls, for instance, could rise to 500,000 per day.^[4] In the same meeting, the ministry also noted “there is a shortage of material and the rate of supply is not meeting the rising demand.”

Many proposals reflect an era when PPE was made of cloth and laundered. Healthcare might be made greener if reusable PPE would be supplied to these medical facilities. Seeing this increased demand, our Institution in collaboration with local textile factory has come up with a low-cost, effective reusable customized PPE which could meet our demands. The customized PPE is made of water-impervious warp and weft polyester fabric 190 threads. The customized PPE consists of full inner coverall with hood, outer gown, shoe cover, and plastic face shield [Figures 1 and 2]. The face shield is made of polypropylene (PP) sheet 30 grams per square meter (GSM). Polyester or polyester-cotton fabric has been approved for reuse by the Centres for Disease Control and Prevention, USA.^[5]

Regarding its reusability, the customized PPE is soaked in 1% hypochlorite for 20 min according to the standards for linen laid down by the Ministry of Health and Family Welfare and National Centre for Disease Control.^[6,7] We have already tested the durability of the fabric and started using in our Institution. In addition, N95 masks, goggles, and gloves are provided with this customized PPE to make it a full PPE. The cost of this customized PPE is Indian Rupees 850 (approx. 11\$) which is much cheaper than the imported expensive PPEs.

Primary care physicians should also wear appropriate PPE to protect themselves from COVID-19 in their daily practice as they are important part of the healthcare system. Fluid-repellent long-sleeved coverall is an important



Figure 1: Customized personal protective equipment (PPE) with all essentials



Figure 2: Healthcare worker wearing the full customized personal protective equipment (PPE) in COVID ward

component of PPE along with N95 mask, goggles, and gloves. But due to shortage of supply, cost factor, and quality control issues associated with PPEs it is challenging to make it available round the clock. This customized PPE which we have suggested is reusable, economical, and can be manufactured in any part of the country would be pertinent for all the primary care physicians in dealing with this pandemic and overcoming this crisis situation.

This customized PPE could be a simple solution to meet the increasing demand by the HCWs and answer to the PPE conservation and supply. Health administrators and government agencies have a role to play in reaching out to suppliers and develop a reliable supply chain system.

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Conflicts of interest

There are no conflicts of interest.

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