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Opinion to Address a Potential Personal Protective Equipment Shortage in the Global Community During the COVID-19 Outbreak

ABSTRACT

The current COVID-19 pandemic is stretching the global supply situation for face masks and PPE beyond production capacity. This is a call for the R&D community, particularly in the polymer degradation and stability arena, to engage and collaborate with virology and bio-medical experts. We require comparative R&D for extended, reuse and recyclability options, as well as large scale approaches and methods that could quickly be applied on the local level by the public who are not experts and may only have limited resources.

OPINION

The COVID-19 outbreak already has and will likely put significant additional strain on hospital resources in many countries if current predictions on the numbers of patients needing hospitalisation and intensive care support become reality. One resource that has been identified as being at risk and has attracted global attention, is personal protective equipment (PPE), in particular and not limited to, filtering facepiece respirators (the widely used face masks) suitable for filtration of airborne pathogens as used by our healthcare professionals and public responders.

Given the current trends witnessed in parts of Europe and North America it is expected that Australia and the United States, as a well as many other countries will suffer escalating numbers of COVID-19 infections requiring hospitalisation in the near future putting tremendous pressure on our healthcare personnel and their services. Considering the existing limited global supply and competition for PPE and face masks, it is therefore expected that severe shortages of protective face masks will be encountered for some countries and communities. While we all hope that such situations will not develop, the time is now to prepare for a worst-case scenario in which the demand for face masks cannot be sustained. Such a situation, which the global community has never had to experience before, will require novel and alternative actions requiring close coordination between our medical and materials engineering, as well as our manufacturing experts and industry. Solutions must be found within temporary and short-term measures of refreshing face masks for extended wear, reusing them after a cleaning process or similar strategies. Now is the time to consider additional risk management solutions to best deal with likely scenarios that we hope to avoid. This is call for action of the global engineering and research communities to immediately consider additional avenues for recyclability, extended use, and the underlying material science for reliable function of PPE and face masks, with many experts particularly well represented in the Polymer Degradation and Stability field.

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Preliminary work as pointers for what can be accomplished exists and a global response has already been triggered. References on disinfection of face masks containing a polymer-fibre filter suggest that under suitable conditions a filtration efficiency of >94.74[1] can be achieved after thermal disinfection treatment without sustaining damage to the filter unit.[2] Disinfection and extended use, though, is not without risk and there are suggestions that some parts of a mask may suffer physical damage during repeated disinfection cycles.[2] By careful monitoring of the material properties before and after disinfection we believe this risk can be managed and viable options for reuse exist. Recycling and disinfection methods may include simple thermal treatments, exposure to hydrogen peroxide vapours, UV or gamma-irradiation sterilisation, ethylene oxide gas, detergent-based cleaning methods or the application of spray-on disinfectants. Indeed, recent news stories have shown some hospitals already using hydrogen peroxide[3] or UV-irradiation[4] on used filtering facepiece respirator type face masks demonstrating ingenuity out of necessity, but also highlighting a need for materials scientists to support these activities as well as develop improved disinfection methods that are robust and amenable to a number of different settings where resources may be highly varied. We need a focus on large scale recyclability approaches, as well as simple and easy to conduct methods within the context of 'anything is better than nothing' that could work on the local level and also be carried out by the public who are NOT experts and may only have limited resources, for example, in countries with less well established healthcare services.

Based on current data, approaches and likely technical feasibility, we present the following recommendations in preparation for an ongoing global pandemic. The overarching goal is clear, namely what can the materials experts offer to enhance the availability of additional PPE and face masks?

The materials R&D community should immediately focus on:

1. Comprehensive evaluation of the many options for PPE and face mask recycling that partially already exist.
2. Strategies for large scale recycling and extended use of PPE and face masks and its impact on material properties and functionality. What could be most easily scaled-up?
3. In parallel explore simple measures that could aid individual users where personal ownership of items is easily maintained. Tracking of individual use and history may also be feasible in hospital settings, thereby enabling perhaps easier acceptance of recycled or re-conditioned items.
4. Best methods for recycling and re-sterilization based on comparative testing. What are the pro and cons of particular approaches? Such questions from the end user and medical community will evolve and must be dealt with.
5. Some of these areas will require close coordination between materials, medical/health, virology and bio-medical experts to achieve ongoing protection and anti-viral properties for reconditioned or recycled equipment.

In parallel, the medical and waste management experts in the health services may wish to consider:

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6. Implementation of short-term alternative waste management strategies at hospitals with waste teams exploring how to separately collect visually reusable face masks and similar PPE as a potential asset to keep for the near future.
7. The impact of different recycling and disinfection methods on the functionality and protective nature of unused masks in comparison with previously used items.

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4. https://www.nebraskamed.com/sites/default/files/documents/covid-19/n-95-decon-process.pdf accessed 29 March 2020

Disclaimer: These are subjective and personal opinions of researchers in the polymer materials reliability field in the context of the current global COVID-19 pandemic only. There is no intent to challenge existing guidelines for PPE/mask use polices or give any preference to PPE/mask manufacturers and any specific technologies that may already exist or are under development.

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Highlights:

- Covid-19 requires rapid R&D and options for reuse, extended use and recycling of PPE and face masks

Declaration of interests

X The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☐The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: