The Grand Challenges in the Design of Respiratory Protection Devices

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Abstract

Protection of healthcare workers in the event of an influenza pandemic is a national imperative and personal protective equipment (PPE) is at the frontline of defense. However, the successful deployment of PPE in the field and acceptance by healthcare workers depends on several factors including efficacy, comfort, usability, wearability, shape-conformability, durability and cost. Among these factors, the need for "fit-testing" of traditional respirators has a significant bearing on the use of such devices in healthcare settings and affects compliance, especially during surge times when the stockpiled respirators are likely to be different from the make/model for which personnel were fit-tested. Consequently, even if a device is *efficient*, it is not *effective* if it is not properly used, or worse, not used at all. Therefore, *simplicity* of use is as important as providing the desired degree of protection. By eliminating the need for fit-testing of respiratory protection devices – the holy grail in respirator design – and making them reusable, the effective use and availability of such devices can be increased in the event of a pandemic and thereby help the nation in its preparedness initiatives.

During the course of the earlier research sponsored by the CDC under the *PanFlu* initiative, the following "grand challenges" in the design of respiratory protection devices were identified: (i) Solving the comfort-safety conundrum: Achieving the porosity-permeability balance; (ii) Enhancing the ease of use: Overcoming the fit-test barrier; and (iii) Creating reusable devices: Maintaining the device performance for reuse to reduce the total cost of respiratory protection.

The presentation will focus on these grand challenges in respirator design for healthcare workers and identify potential paths to address them using a judicious combination of materials, structures and manufacturing technologies.