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Letter to the Editor

Strategies to maintain an N95 respirator supply during a pandemic supply-chain shortage

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In the early phase of the coronavirus disease 2019 (COVID-19) pandemic, multiple healthcare systems in the United States were overwhelmed by critically ill patients. Hospitals at the epicenter of the outbreaks encountered shortages of personal protective equipment (PPE), especially N95 respirators. In March 2020, as COVID-19 cases began to increase in our region, our organization anticipated PPE shortages due to increased demand on the national supply chain. We solicited donations from the community and were subsequently inundated with respirators in varying styles, sizes, conditions, and quantities. A transdisciplinary team from infection prevention, operational efficiency, environmental health and safety, supply chain, and medicine was formed to evaluate and operationalize donations to provide HCP with safe and effective N95 respirators.[1]

Donations comprised 360,000 N95s consisting of 71 respirator models with quantities ranging from dozens to tens of thousands per model. We describe our systematic, quality-driven approach to proactively maintain an adequate and effective respirator supply at our ~960-bed academic medical center.

Methods

Our team began by using the Centers for Disease Control and Prevention (CDC) and National Institute of Occupational Safety and Health (NIOSH) websites to validate and classify each respirator model as an approved surgical respirator, approved alternate respirator (ie, provided 95% or equivalent filtration but may have lacked fluid barrier protection, had an exhalation valve, or were manufactured to another country's standards), or unapproved or possibly counterfeit respirator.[2,3] Next, we developed a categorization system, and respirators were sorted based on the quality, style, and condition of the donation. Quality ranged from superior (surgical N95s with FDA approval) to what we termed, "respirators of last resort" (possible counterfeits and those that were not approved by the CDC and NIOSH).

The team identified respirators of the highest quality with significant quantity and submitted these to the Center for Environmental Medicine, Asthma, and Lung Biology for testing. Using the NIOSH Fit Testing Protocol for Filtering Facepiece Respirators the Center assessed the fitted filtration efficiencies (FFEs) on a male and female test participants.[4] We used the FFEs to determine which donations provided at least N95 level filtration as a criterion for use. Next, we performed quantitative fit testing (TSI PortaCount Pro+ model 8038) on a small group of HCP previously fit tested to 1 of our 4 respirator models to identify which respirators fit the most users.[5] For the respirators that passed our testing, we assessed the total quantity available to prioritize distribution and reduce HCP confusion. The process and corresponding numbers of donated respirator models evaluated at each stage are shown in Figure 1.

In addition, HCP were sent a survey in November and December 2020 to assess satisfaction with our organization's management of PPE during the COVID-19 pandemic. This study was approved by our institutional review board.

Results and discussion

Individual HCP are typically matched to properly sized respirators through a fit-testing process. This poses a high level of complexity when distributing multiple alternate respirators of limited quantity among thousands of respirator users. During the pandemic-related supply shortages, HCP fit-tested on a specific respirator would sometimes discover that the supply of their model was exhausted. To reduce HCP stress surrounding frequent PPE changes and to improve stability to our respirator supply, we developed a systematic approach to distribute our donated respirators to the largest supply and limit the number of new respirator models in distribution at any point in time.

In total, 24 models of respirators with sufficient quantities (>1,000) were evaluated. Among these, 14 (58%) were deemed less

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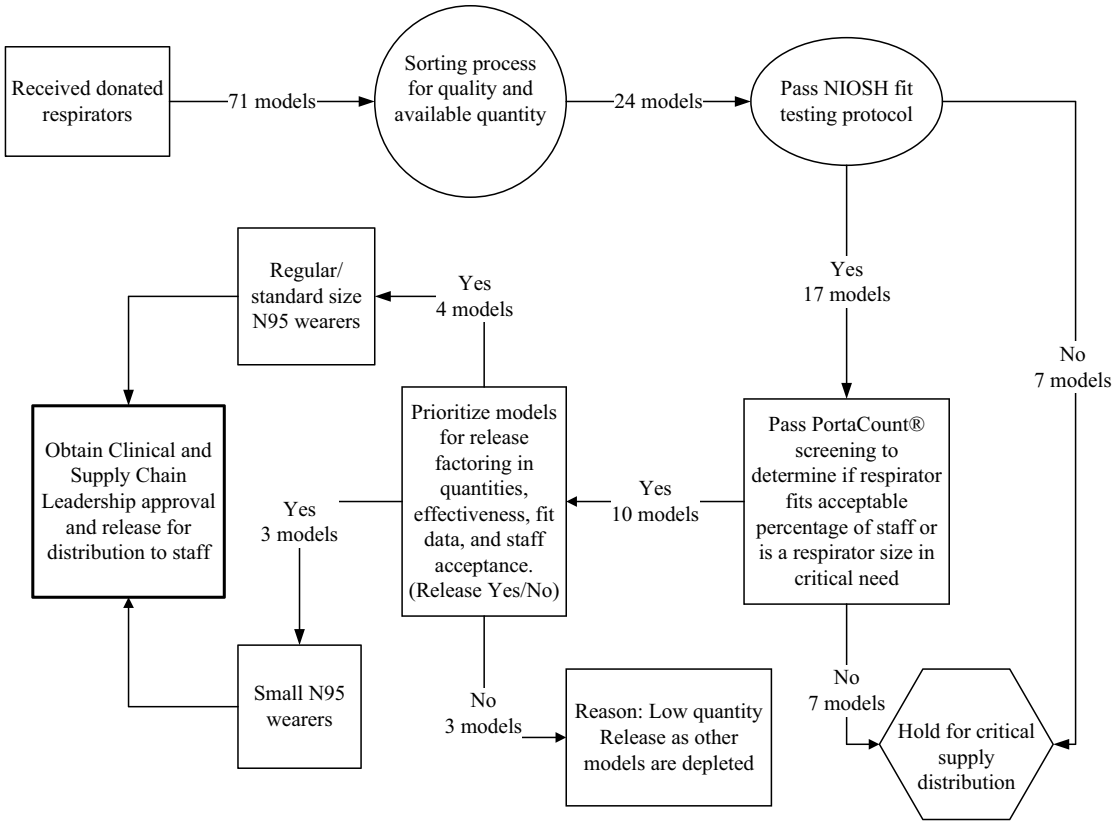

Figure 1. Sorting and testing process outcomes of donated respirator devices.

than ideal due to NIOSH fit-testing filtration effectiveness or PortaCount screening for fit. These respirators were held for release in case supplies became even more critical. In total, 7 models of respirators were determined to be acceptable alternates to typically stocked respirator models and were managed for distribution through our supply chain. These products were offered as alternatives based on the described testing procedures. Staff were reminded of the process of user seal checks as a "just in time" mechanism. During repeated supply delays and shortages, the donated respirators were crucial to patient care and HCP safety. The management of donated respirators by our trans-disciplinary team eliminated the need to release our stockpile of previously used and then disinfected N95s.

A majority of the 680 HCP surveyed agreed (33%) or strongly agreed (49%) they had all the PPE they needed available. Of those who disagreed (7%) or strongly disagreed (5%), many reported working in outpatient settings where patients were screened for COVID-19 symptoms before appointments and CDC guidance stated that face masks and eye protection were appropriate. Our respirator supply was targeted to HCP in inpatient and emergency department settings for use with patients known or suspected to have COVID-19.

Collaboration between teams from a variety of disciplines, using quality improvement principles, resulted in a sustainable method for receiving, sorting, and evaluating donated respirators and ensuring delivery of a steady supply of effective respirators to bridge supply-chain shortages. Quantitative fit testing to determine overall effectiveness and emphasizing the importance of the user seal check when utilizing a new type of respirator were a few of the components in our process.[6] A quality-driven approach was an efficient and effective strategy to distribute respirators during a global PPE shortage at a large academic medical center.

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