JOHNS HOPKINS BLOOMBERG SCHOOL of PUBLIC HEALTH | Center for Health Security

Interim Estimate of US PPE Needs for COVID-19

April 18, 2020

Eric Toner, MD

As the first wave of the COVID-19 pandemic sweeps across the United States, there have been numerous reports of shortages of essential medical supplies, including personal protective equipment (PPE). These shortages threaten the safety of healthcare workers and patients and undermine the medical response to the pandemic. The magnitude of the need for PPE due to the pandemic in the United States has not been estimated publicly. Here we provide an initial estimate of the incremental need for medical PPE of various kinds above normal baseline utilization for a single 100-day COVID-19 wave. This estimate will be updated as information changes.

Our Estimates

Based on our assumptions and calculations, we expect the need for following additional PPE supplies above and beyond what is needed in normal times. This includes healthcare PPE used for hospital inpatients (intensive care and non–intensive care), emergency departments, emergency medical services, outpatient visits, and nursing homes. Per capita numbers are based on the US population. All total figures are rounded to the nearest million.

Incremental need for a single 100-day COVID-19 wave, assuming strict social distancing (rounded to nearest million)	**US Total**	**Per capita (US pop)**
Gloves (combined sterile and exam gloves of all types and sizes)	3.393 billion	10.28
Isolation gowns	321 million	0.97
Medical-grade masks (combined surgical, procedure, and isolation masks of all types)	179 million	0.54
N95 or similar disposable respirators	57 million	0.17

These calculations apply only to a single disease wave and assume strict adherence to all social distancing and community mitigation efforts existing on April 8, 2020. If subsequent waves of illness recur, additional supplies of PPE will be needed. Furthermore, these calculations assume implementation of crisis standards of care regarding PPE conservation, such that there are substantial deviations from normal infection control practice.

In addition, if there is widespread use of medical masks by the public, the number of masks needed could increase by an additional **45 million or more per day** (1.372 billion per month) until a vaccine is available.

Our Calculations and Assumptions

These estimates are based on limited evidence. Neither the magnitude nor duration of the COVID-19 wave is known with certainty. Likewise, how healthcare workers and facilities will adapt to shortages can only be estimated. A description of our major assumptions follows. Undated versions of this document along with details of the assumptions and the spreadsheet used for the calculations are available at www.centerforhealthsecurity.org/PPE-assumptions.

The epidemiological parameters of the disease wave. There have been several published and unpublished models of the pandemic in the United States. Because the least reliable data relate to the number of cases (due to lack of testing and asymptomatic cases), we based our calculations on estimates of the number of deaths. We estimate deaths in the United States (252,000), then work backward to calculate the number of implied ICU and non-ICU admissions (353,000 and 1.4 million, respectively) and total symptomatic cases (9.4 million), based on published ratios.. These figures produce an attack rate of 2.85% and a case fatality ratio of 2.68.1%, which are consistent with published data from many countries. If social distancing is more or less effective than assumed, these calculations will change.

Medical utilization of PPE. The degree of PPE use varies according to the clinical setting. We calculated utilization for ICU, non-ICU, emergency department (ED), outpatient, emergency medical services (EMS), and nursing homes. Based on many anecdotes and news stories, we understand that healthcare workers have adapted to shortages by modifying normal protocols for PPE use, which we assume will continue. For example, in settings where COVID-19 patients are cohorted, healthcare workers use a single item for multiple COVID-19 patient encounters, instead of disposing of masks and gowns after each use. We assume that gloves will continue to be changed between all patient encounters to prevent spread of other pathogens, such as MRSA and *C difficile*. We assume that N95 respirators, rather than powered air-purifying respirators (PAPRs) or elastomeric facemasks, will be used in the vast majority of COVID patient care where high-level protection is needed. We also assume that simple masks will be used for most COVID-19 patient encounters except for high-risk settings, such as aerosol-generating procedures. We have not considered face shields or goggles

or foot coverings. We know that there is a wide spectrum of approaches that healthcare facilities are employing to conserve PPE. We have used our judgment as to what we consider prudent and middle-of-the road, but we realize that even our assumptions may not be possible due to severe shortages in some locations.

Use by the general public. The Centers for Disease Control and Prevention (CDC) and the White House are now providing guidance to the general population to use simple nonmedical masks when in public. Currently, the recommendation is to wear home-made cloth masks so as not to divert masks away from healthcare workers, but as medical-grade masks become more plentiful, it is likely that there will be a shift by the public to those better-quality items. We assume that, after adjusting for home-bound individuals, mask use may eventually be used by 50% of the population and that they will use, on average, 1 mask per day.

Implications

It is our intent to provide an order of magnitude target for suppliers and policymakers. While we have included many healthcare settings, we have not included all possible settings, such as home care or residential senior care. As startling as these numbers may seem, they represent a near best-case scenario. If the pandemic in the United States is more severe or more prolonged than we assume, or if healthcare workers do not adapt such robust PPE conservation measures, these numbers could increase by many-fold. However, we believe that relative shortages will force conservation measures for the duration of the wave. It is not clear what the supply chain manufacturing capacity is for these various items, and news reports indicate that manufacturing is ramping up, so it is not clear how quickly these needs can be met. Although we cannot now estimate how well the gap in PPE supplies is being filled, we believe there is value in understanding the magnitude of the need.

These estimates, along with the assumptions and spreadsheet, will be updated as new information is learned and can be accessed at www.centerforhealthsecurity.org/PPE-assumptions.

