The COVID-19 Pandemic and Wildfire Smoke: Potentially Concomitant Disasters

See also Morabia, p. 1111, and the *AJPH* COVID-19 section, pp. 1123–1172.

As we enter the wildfire season in the northern hemisphere, the potential for a dangerous interaction between SARS-CoV-2 and smoke pollution should be recognized and acknowledged. This is challenging because the public health threat of COVID-19 is immediate and clear, whereas the public health threat of wildfire smoke seems distant and uncertain in comparison. However, we must start preparing now to effectively manage the combination of public health threats that we may face in the months ahead.

WILDFIRES AND SMOKE

Global wildfire seasons are increasing in length, intensity, and severity owing to complex factors including traditional forest management practices and climate change. Australia has been the most recent and extreme example, but many other regions have experienced record-breaking seasons over the past few years. Indeed, there have been catastrophic wildfires in western North America during each of the summers of 2016 through 2019, with no reason to expect anything different in 2020. These events cause episodes of extremely poor air quality that can affect very large populations. Wildfire smoke is a complex mixture of many air pollutants with public health relevance[1] but is often characterized by elevated concentrations of fine particulate matter ($PM_{2.5}$) that can last for days, weeks, or months.

AIR POLLUTION AND ACUTE RESPIRATORY RISK

The number of studies on wildfire smoke and its acute health effects is small compared with the wider literature on ambient air pollution. Even so, the associations between $PM_{2.5}$ and all respiratory outcomes are clear and relatively large on smoky days. A recent meta-analysis reported a 6% (confidence interval [CI] = 2%, 9%) increase in asthma-related hospital admissions for each 10 micrograms per cubic meter increase in $PM_{2.5}$ from wildfire smoke, which is larger than the expected effect for the typical ambient $PM_{2.5}$ mixture.[2] Although there is limited evidence specific to wildfire smoke, exposure to $PM_{2.5}$ has consistently been associated with increased susceptibility to respiratory viral infections.[3] The mechanistic pathways are not fully described, but most evidence suggests that air pollution exposure leads to immunosuppression, inflammation, and decreased inactivation of pathogens by macrophages. If SARS-CoV-2 continues to circulate through the summer and if the wildfire season turns out to be extreme, smoke pollution may increase population susceptibility to the virus and cause more cases of severe disease.

POTENTIAL AMPLIFICATION OF COVID-19

The magnitude of the impact is impossible to predict, but one study on the severe acute respiratory syndrome (SARS) coronavirus outbreak in Beijing reported a 6% (CI = 0%, 12%) increase in the relative risk of mortality for each 10 micrograms per cubic meter increase in the five-day mean of total respirable particulate matter (PM_{10}), which comprises $PM_{2.5}$ and larger particles.[4] Although the ambient air pollution mixture in China is quite different from wildfire smoke, a recent study in New York State found that biomass burning was more strongly associated with laboratory-confirmed cases of influenza than any other constituent of total $PM_{2.5}$.[5] Assuming that the 6% estimate for the effect of ambient PM_{10} on SARS in China holds true for the effect of wildfire smoke $PM_{2.5}$ on COVID-19 in North America, we can use a quantitative approach to visualize and better understand the potential impact of smoke on population morbidity and mortality.

Consider a counterfactual scenario in which the entire Washington State COVID-19 outbreak was occurring under the air quality conditions experienced in King County during summer 2018 rather than spring 2020 (Figure 1). If the smoke episode started as the outbreak was growing (March 18, 2020), the counterfactual counts of confirmed cases and deaths on April 16, 2020, would have been 12 456 and 632, respectively, compared with the actual counts of 11 057 and 579, respectively.

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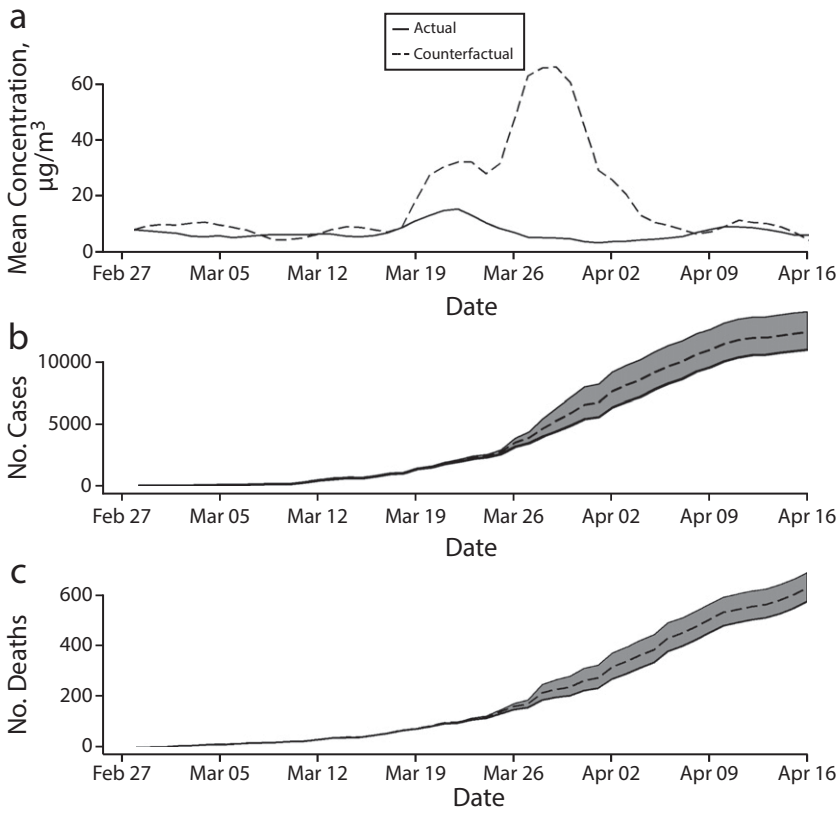

Note. The figure shows actual (February 28–April 16, 2020) and counterfactual (July 25–September 9, 2018) 5-day average measurements of $PM_{2.5}$ in King County, WA. The difference between the actual and counterfactual has been used to examine the potential impacts of wildfire smoke on confirmed COVID-19 cases and deaths in all of WA using effect estimates adapted from the study of respirable particulate matter (PM_{10}) and severe acute respiratory syndrome (SARS) coronavirus in Beijing.[4] Gray polygons show the 95% confidence intervals of the estimates (dashed lines).

FIGURE 1—Potential Impacts of a Wildfire Smoke Episode on COVID-19 in Washington State by (a) 5-Day Mean Fine Particulate Matter ($PM_{2.5}$) in King County, (b) Number of Confirmed Cases, and (c) Number of Confirmed Deaths

Simply put, a wildfire smoke episode of moderate magnitude and intensity has the potential to increase the impact of a COVID-19 outbreak by approximately 10%, with its timing along the epidemic curve being a key consideration. Although there are many uncertainties in this hypothetical exercise, it helps to contextualize the nature of the concern.

PUBLIC HEALTH PREPAREDNESS IS PARAMOUNT

It is currently unclear how the COVID-19 pandemic will persist in warmer weather, but preliminary analyses suggest that temperature will not significantly reduce case counts in the absence of public health intervention (https://bit.ly/3eERH8t). Regardless, the only way to reduce wildfire smoke's potential amplification of COVID-19 is to reduce population exposure, the options for which are quite limited. We simply cannot rely on suppression of wildfire under current conditions, meaning that we must be prepared for smoke when it arrives. One of our best defenses is cleaner indoor air, given that most people spend the vast majority of their time inside. However, effective maintenance of good indoor air quality requires a lot of planning, especially in the acute and long-term care facilities where those most vulnerable to COVID-19 reside.

Most parts of western North America have experienced extreme wildfire smoke in recent years, meaning that planning for improved indoor air quality should already be under way. Unfortunately, the reactive response to COVID-19 may jeopardize a proactive approach to wildfire smoke because of shifting priorities and limited resources. If so, we neglect the potential harms of the upcoming summer at our peril. Although we can hope for a moderate wildfire season with limited smoke, the record-breaking seasons of the past decade should serve as a warning to prepare for the worst. It is far better to start thinking about the potential amplification in risk now, rather than waiting until wildfire is on us.

PREPARATION IN THE FACE OF COVID-19

Even in the absence of COVID-19, preparation for the wildfire season should start as early as possible. Clinicians should already be getting informed (https://bit.ly/2Y0heCY) and talking to their higher-risk patients about how to protect themselves from wildfire smoke. Given that access to community cleaner air shelters may be limited because of distancing guidelines, more emphasis should be placed on sheltering at home and using portable air cleaners.[6] However, the advice to close windows and doors conflicts with advice to reduce COVID-19 transmission through improved ventilation and may lead to overheating in warm climates. A good compromise is to balance risks by identifying specific rooms that can be effectively cleaned and cooled to offer respite when needed (https://bit.ly/2VWj84S). Another conflict arises around cloth and surgical face masks, which may help to reduce COVID-19 transmission but offer limited protection from the $PM_{2.5}$ in wildfire smoke. Only well-fitted N95 respirators can offer good protection, but they must be reserved for front-line health care workers if supplies are limited during the pandemic. Furthermore, N95 respirators may increase risk among those most vulnerable to

smoke and COVID-19 because of increased breathing fatigue.[7]

In addition to personal protective actions, health care administrators should be assessing their facilities in consultation with heating, ventilation, and air conditioning professionals to develop wildfire smoke plans and to ensure that any necessary supplies are available for the summer months (which may take more time than expected with disruptions to global manufacturing and supply chains). This is particularly true for long-term care facilities, which have more variable indoor air quality than hospitals and have been very susceptible to severe COVID-19 outbreaks. Finally, environmental public health professionals should push even harder for wildfire smoke preparedness in 2020 than we would in any other year. Many of our colleagues are stretched too thin to contemplate wildfire season right now, and they need us to bring the potential future risks into focus. Be helpful, be compassionate, and be insistent. We may not be on the front lines of this public health disaster, but raising our voices now may pay dividends for everyone in the future. AJPH

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CONFLICTS OF INTEREST

The author has no conflicts of interest to declare.

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