

# Wildfire Threat to Inpatient Health Care Facilities in California, 2022

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**Objectives.** To assess wildfire risks to California inpatient health care facilities in 2022.

**Methods.** Locations of inpatient facilities and associated inpatient bed capacities were mapped in relation to California Department of Forestry and Fire Protection fire threat zones (FTZs), which combine expected fire frequency with potential fire behavior. We computed the distances of each facility to the nearest high, very high, and extreme FTZs.

**Results.** Half (107 290 beds) of California's total inpatient capacity is within 0.87 miles of a high FTZ and 95% (203 665 beds) is within 3.7 miles of a high FTZ. Half of the total inpatient capacity is within 3.3 miles of a very high FTZ and 15.5 miles of an extreme FTZ.

**Conclusions.** Wildfires threaten a large number of inpatient health care facilities in California. In many counties, all health care facilities may be at risk.

**Public Health Implications.** Wildfires in California are rapid-onset disasters with short preimpact phases. Policies should address facility-level preparedness including smoke mitigation, sheltering measures, evacuation procedures, and resource allocation. Regional evacuation needs, including access to emergency medical services and patient transportation, must also be considered. (*Am J Public Health*. Published online ahead of print March 2, 2023:e1–e4. <https://doi.org/10.2105/AJPH.2023.307236>)

California is experiencing an intensifying wildfire crisis. Of the 20 largest wildfires in the state's history, all but 3 took place in the past 2 decades, with 7 occurring in 2020 and 2021.<sup>1</sup> Wildfires pose a threat to the structural integrity, operations, and accessibility of health care facilities, accounting for 18.4% of hospital evacuations in the United States during the 21st century.<sup>2</sup> Recent examples in California include evacuations from hospitals in Sonoma County, sometimes twice within the same fire season.<sup>3</sup> Inpatient facility evacuations are a complex process and often require coordination across health systems and jurisdictions. They can pose a danger to patients and staff, even when advance warning is available.<sup>4,5</sup> In this article, we use publicly

available data to assess the burden of wildfire risk to inpatient health care facilities in California and identify regions at high risk.

## METHODS

The California Department of Health and Human Services provides location and capacity information for all 15 684 licensed and certified health care facilities in California. In this study, we analyzed data updated as of October 2022 for licensed inpatient facilities, which treat patients for longer than 24 hours and may have complex evacuation needs.

The California Department of Forestry and Fire Protection (CAL FIRE) Fire and Resource Assessment Program

classifies the state into 6 ordinal fire threat zone (FTZ) categories: not mapped, low, moderate, high, very high, and extreme. The threat zones "combine expected fire frequency with potential fire behavior," representing "the relative likelihood of damaging or difficult to control wildfires occurring for a given area."<sup>6</sup> As defined by CAL FIRE, the zones "can be used to assess the potential for impacts on various assets and values susceptible to fire[, and] impacts are more likely to occur and/or be of increased severity for the higher threat classes."<sup>6</sup>

Digital rasters representing fire threat obtained from CAL FIRE were converted to polygons at a 270-meter resolution, and nearest neighbor analyses were used to compute the distance from

each facility to the nearest high, very high, or extreme FTZ.<sup>7</sup> Facilities within FTZs were assigned a distance of zero. The bed capacity for each facility was used to compute the distance of inpatient beds from each FTZ level.

We used Excel (Microsoft Corporation, Redmond, WA), QGIS version 3.16.7 (Open Source Geospatial Foundation, Beaverton, OR), and Python version 3.8 (Python Software Foundation, Wilmington, DE) in our analyses. All codes and underlying data are provided in Appendixes A through D (available as supplements to the online version of this article at <http://www.ajph.org>).

## RESULTS

We included a total capacity of 214 358 inpatient beds (across 3087 inpatient facilities) in our analyses: 74 041 general and acute care beds at 429 facilities, 8961 beds at 135 behavioral health facilities, and 131 356 long-term care

beds at 2523 facilities. Our results showed that 4 facilities are within a very high FTZ and 22 are within a high FTZ; 50% of total inpatient capacity (107 290 beds) is within 0.87 miles of a high FTZ (Figure 1), and 95% of capacity (203 665 beds) is within 3.7 miles of a high FTZ. In addition, half of the total inpatient bed capacity is within 3.3 miles of a very high FTZ and 15.5 miles of an extreme FTZ.

Median distance to an FTZ varies by county. The state's northern counties are disproportionately affected: there is lower overall capacity in these counties, and the median distances to high, very high, and extreme FTZs are substantially shorter. In the southern half of the state, San Luis Obispo County has the most inpatient facilities that are near FTZs (Appendixes B and C).

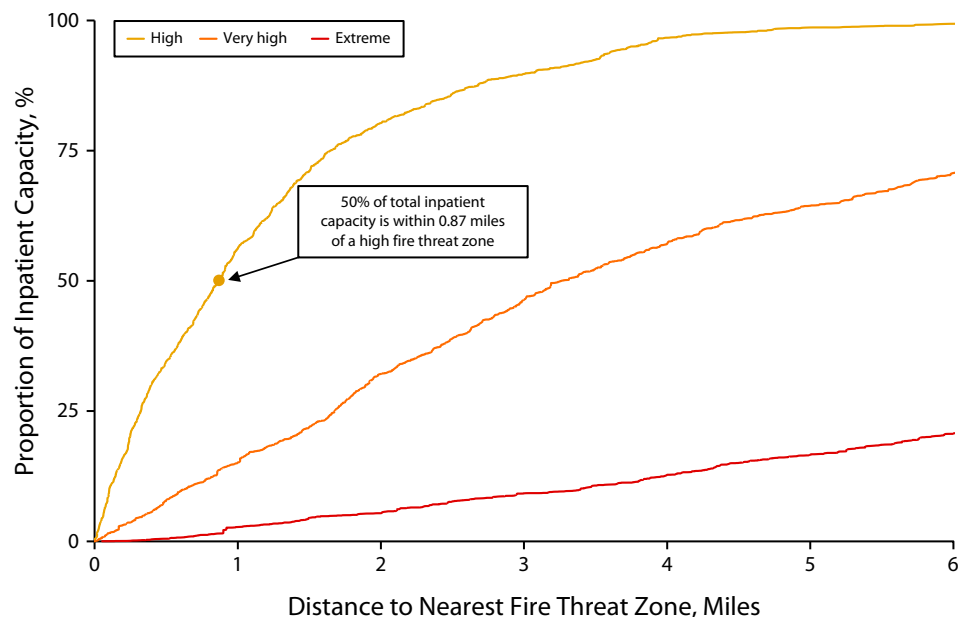
## DISCUSSION

Wildfires in California can be rapid-onset disasters with a short preimpact

or warning phase. This has left health care facility leadership and emergency preparedness specialists the option of either preparing hospitals for rapid evacuations or investing in adaptations that will allow hospital staff and patients to shelter in place until the wildfire no longer poses a threat.

Even if a facility is not under immediate threat of structural damage, smoke exposure, road closures, and infrastructure damage from nearby wildfires can have a longitudinal impact on health care system functioning and access to care.<sup>8</sup>

We found that a high percentage of inpatient health care facilities in California are at risk for potential operational disruption or evacuation from wildfires. Facilities near wildfires may face risks from windblown embers, transportation interruptions, and conversion of wildland fires to structure fires, which can affect the safety, operability, or accessibility of facilities or increase the risk of fire at facility sites.



**FIGURE 1**— Distance of Inpatient Facilities From Fire Threat Zones: California, 2022

*Note.* The vertical axis represents the total inpatient capacity across the 3087 study facilities. The horizontal axis represents the distance from each facility to the nearest fire threat zone. Further methodological details are available in the Appendixes, available as a supplement to the online version of this article at <http://www.ajph.org>.

In northern counties—where 2 of California's largest fires burned more than 1 million acres over the past 2 years—health care accessibility is a significant concern because of high levels of hazard exposure and limited numbers of beds and facilities.

The large number of facilities at risk (despite representing a small proportion of total facilities) creates the possibility of complex evacuation needs as a result of the many potential sending and receiving facilities in a major fire scenario.

## Limitations

The information on fire risk exposure reported here is based on CAL FIRE data and as such reflects current risk estimates.<sup>6</sup> Future fire risk in various climate change scenarios was not assessed and is expected to exceed current risk levels in many locations. Fire occurrence, propagation, and overall risk is a complex issue involving numerous dynamic variables. CAL FIRE FTZs are believed to be the best available source on which to base an analysis of such factors.

We did not attempt to assess or compare structural characteristics that could improve fire resistance or the degree of fire protection afforded by small-scale geographic features such as impervious surfaces and nonvegetated areas in health facilities' immediate environment, nor did we consider features that contribute to facility-level resilience such as backup generators and on-site fire suppression capabilities. Caution should be exercised when interpreting negative results; although a facility may not be near an FTZ or an active fire, facility operations may nonetheless be affected.

## Public Health Implications

Our findings demonstrate widespread wildfire risk to inpatient health care facilities, including threats to much of the inpatient bed capacity in California. General hospitals are of particular concern because of difficulties associated with evacuation of hospitalized patients, limited numbers of alternate facilities to which patients can be evacuated, and the potential for loss of access to emergency care that accompanies even temporary closure of facilities.<sup>9</sup>

The long-term care facility patient population is at high risk during evacuation; previous research demonstrates increased mortality during and after nursing home evacuations.<sup>10</sup> Involuntarily hospitalized patients in behavioral health facilities have special security needs during wildfire contingencies, making evacuation a complex undertaking.

We urge health facility leaders to assess the vulnerability of facilities to wildfire hazards and to prepare for both sheltering-in-place and evacuation scenarios. If sheltering patients and community evacuees is necessary, facilities must be prepared to optimize and allocate resources and have measures in place to mitigate the risk of wildfire smoke exposure. Health care facilities also should prepare for evacuation scenarios in which emergency medical services and patient transport resource availability may be scarce and access routes may be affected.<sup>11</sup>

The interinstitutional, transjurisdictional coordination and cooperation that will be required to minimize health care interruptions will necessitate investments in data architecture, community awareness, and infrastructure resilience.<sup>12</sup> Priorities may vary from region to region, reflecting differing regional risk profiles.

As the climate crisis continues to raise wildfire risk, it is vital to protect inpatient health care facilities so that they can meet the needs of their communities.

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## CONTRIBUTORS

N. S. Bedi and C. Dresser conceived and designed the project, collected and analyzed data, and led the writing process. A. Yadav supported the conception and design and contributed significantly to analysis of the data. A. Schroeder and S. Balsari supported the project throughout, providing leadership, insight, and resources, and contributed significantly to the writing process.

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## CONFLICTS OF INTEREST

All authors declare no competing interests.

## HUMAN PARTICIPANT PROTECTION

Publicly accessible data were used in this study. No human participants were involved.

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