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Supporting Wildfire Response During a Pandemic in the United States: the COVID-19 Incident Risk Assessment Tool

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The onset of the global pandemic in 2020 significantly increased the complexity and uncertainty of wildfire incident response in the United States, and there was a clear role for decision support to inform and enhance coordination and communication efforts. Epidemiological modeling suggested the risk of COVID-19 outbreak at a traditional large fire camp could be substantial and supported the broadscale implementation of mitigations, and management of COVID-19 required expanding the response network to interface with entities such as local public health agencies, hospitals, and emergency operations centers. Despite the early issuance of medical and public health guidance to support wildfire management functions under a COVID-19 modified operating posture, an identified gap was a scale- and scope-appropriate tool to support incident-level assessment of COVID-19 risk. Here we review the development and application of a COVID-19 Incident Risk Assessment Tool intended to fill that gap. After prototyping with fire managers and risk practitioners, including early-season use on several incidents, we built an online dashboard that was used operationally throughout the 2020 fire season. We summarize usage statistics, provide some examples of real use on wildfire incidents, and report feedback from users. The tool helped to fill a critical information gap and was intended to support risk-informed decision-making regarding incident logistics, operations, and Januar an9 an9 Jidents,

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of the incident increases, which necessitates networked coordination and communication across a variety of functions and with numerous local agencies, managers, and stakeholders (Nowell and Steelman, 2015; Nowell et al., 2018; Steelman and Nowell, 2019). Accordingly, there is a clear role for decision support to inform and enhance coordination and communication e orts (Greiner et al., 2020; Rapp et al., 2020).

moderate (14–18), and high (19–30).

$$IRS = \sum_{i} \alpha_i \, FRS_i + \beta$$

$$FRS_i = \sum_{j} \gamma_{ij} \, SFRS_{ij}$$

Where:

IRS	Incident Risk Score
i	Index for factor (*i*)

Figure 1 displays the conceptual rose chart for how risk scores and ratings were visualized. The dashboard automatically creates figures for each factor and sub-factor and for the overall incident-level score. Each "petal" corresponds to an individual risk sub-factor, the size and color of which vary depending on the assigned score. **Figure 2** displays how each factor and sub-factor are rated on the dashboard itself. The greater the size of a petal, the greater its contribution to overall risk. **Table 2** displays the risk assessment worksheet that forms the basis for how the chart is created. This worksheet was available for users as information and as a tool to download and fill out by hand. In practice, the target user base is a comparatively small fraction of the fire management community; one or a few persons per Incident Management Team would be sufficient to gauge risk and initiate meaningful conversation.

Prototyping, Communication, and Outreach

In late June and early July 2020, an initial version of the risk assessment tool was used on multiple wildfire incidents in the southwestern United States. At the time, we had only developed the framework and shared an image mirroring the depiction of the tool with the relative risk assessment from WFDSS. Assessment results were hand-drawn and shared with accompanying text narrative. Based on positive feedback from regional risk management specialists familiar with the tool's operational use, we proceeded with updating the graphical model and developing the software to streamline and expand the use of the online risk assessment tool.

In addition to working with subject matter experts and relying on their respective networks, we used multiple channels to share information about the COVID-19 Incident Risk Assessment Tool. Early on, we briefed senior leadership of the USDA Forest Service, who offered their support for continued development and use. We coordinated closely with agency personnel from Fire and Aviation Management, Office of Communications, and the Rocky Mountain Research Station. With their assistance, we developed an informational webpage about the project as well as an online tutorial hosted on the dashboard[5].

[5]https://www.fs.usda.gov/rmrs/tools/covid-19-fire-incident-specific-risk-assessment-tool

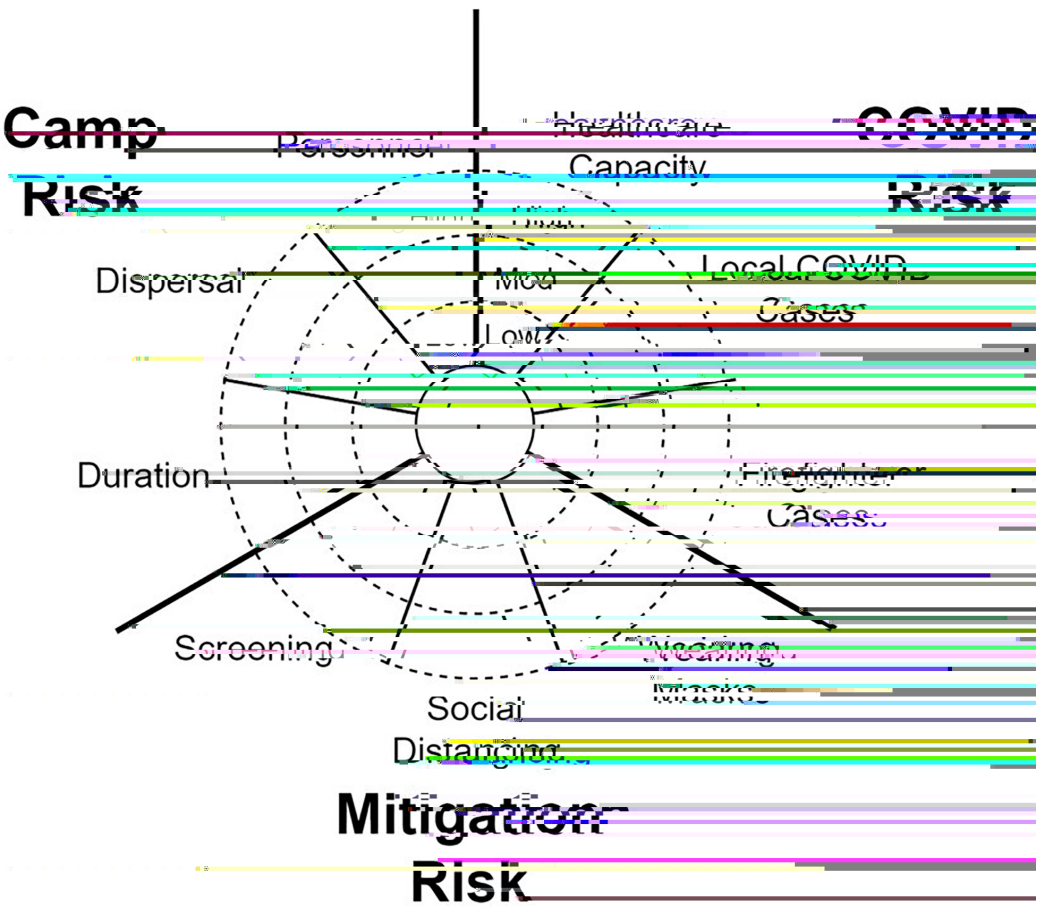

FIGURE 1 | Conceptual

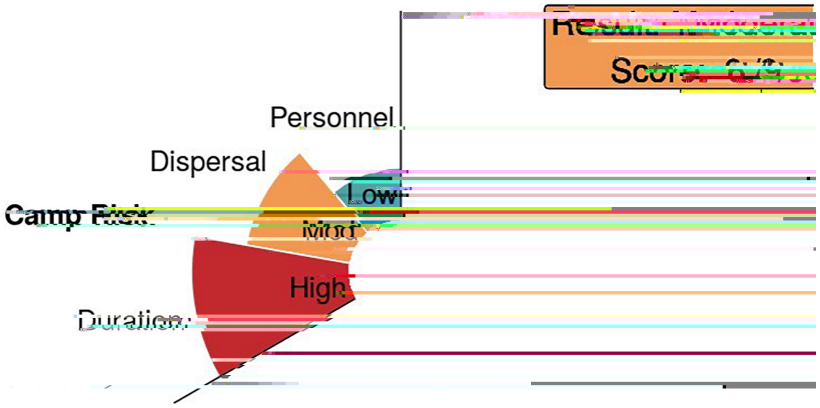

FIGURE 2 | Illustration of filling out rose chart on the online dashboard.

TABLE 2 | Risk Assessment Worksheet that lays out the risk scoring and rating system all factors and sub-factors.

Risk factors	Low risk	Moderate risk	High risk	Score

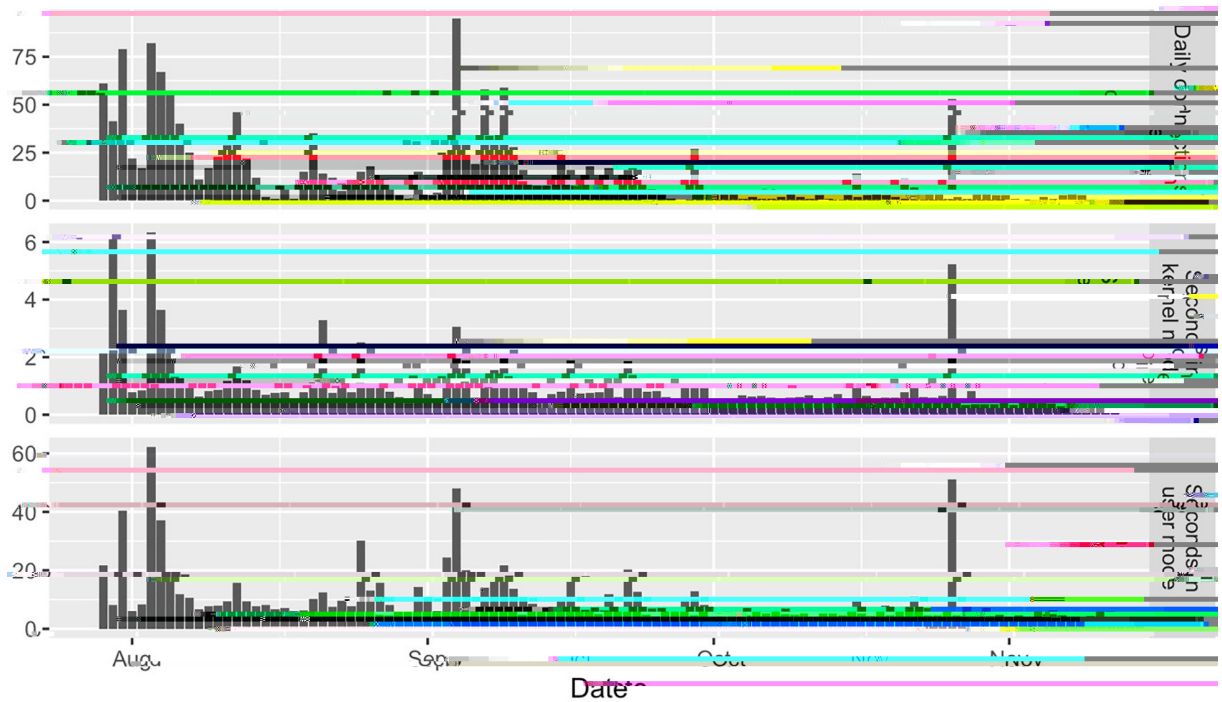

FIGURE 3 | The daily connections, daily CPU usage in kernel mode, and daily CPU usage in user mode as tracked by the shiny.io server for 28 July 2020 through 10 November 2020.

2020. However, we also observe ongoing routine usage of the app between publication events.

To improve tracking of dashboard usage, on 10 September 2020, we enabled tracking by Google Analytics. We used the standard Google Analytics settings. The use of Google Analytics allowed us to track additional data on users, including location, and if the visitor was new or returning. **Figure 4** shows the geographic distribution of new and returning users from 10 September 2020 through 10 November 2020. The dashboard saw usage across all regions of the United States, both for new visitors and returning visitors. According to the tracking done by Google Analytics, most users of the dashboard visited only once (150 users between 10 September and 10 November 2020). However, there were 20 users who visited the dashboard twice and 15 users who visited the dashboard between 7(use10)-[0 mi9(t)-4t twice