Monitor and Mitigate the Impact of COVID-19 on Public Safety

Literature Review: Final Report

March 7, 2021

In partnership with:

Second Sight Training Systems

About This Report

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About Second Sight Training Systems

SSTS is a research and training company focused on providing research driven online and instructor –led training to military, security, and law enforcement. For more information, contact Second Sight Training Systems at info@secondsight-ts.com or visit https://www.secondsight-ts.com/.

Citations

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Executive Summary

The ongoing COVID-19 pandemic has imposed human and financial costs on the country's first responders, who risk exposure in their jobs and must maintain operations to ensure the safety of the communities they serve. Given the ongoing nature of the COVID-19 pandemic, this literature review is part of a larger multi-phase project to provide first responders short-term guidance based on the current state of knowledge while offering improved and more in-depth analysis over time.

This review is focused on scholarly research that informs our understanding of how first responder organizations are being affected by the COVID-19 pandemic, how they have responded to or were impacted by similar events in the past, and how they can provide services during pandemics in the future. It includes research from government and non-government sources, and ranges from observational studies that describe the impacts on personnel to evaluations of interventions designed to protect staff or maintain service delivery at the organizational level. The document was also reviewed by subject matter experts from the police, fire, and EMS community to provide additional insight and to identify gaps in collected research.

This review is based on a systematic approach to evidence-gathering and grounded in established methods of systematic reviews (Booth, Sutton, & Papaioannou, 2016; Levy & Ellis, 2006; Machi & McEvoy, 2016). Our methods are modeled after the processes seen in Campbell Systematic Reviews and adapted to suit the mission of the Department of Homeland Security (DHS) to provide a comprehensive understanding of COVID-19, what we know about its effects on first responders, and what we do not.

Our focus involved research tied to COVID-19 and other crises (including natural disasters like Hurricane Katrina and infectious disease outbreaks like H1N1) from which we may be able to draw meaningful conclusions. We collected and reviewed a wide variety of studies that cover multiple aspects of how first responders are impacted by COVID-19 and similar events from the recent past. While more research continues to be published on COVID-19, past crises and the body of knowledge will grow, the collected literature to date can teach us a great deal about how first responders are impacted by and can successfully respond to the current crisis.

Our collection, coding, and review process had four stages:

1) Collect COVID-relevant research documents and storing these files in an online library.

2) Complete a Secondary Inclusion Check, where the team reviewed collected literature and made a final determination for inclusion for categorization in Stage 3.

3) Categorize collected research based upon various features, such as study type (qualitative, quantitative), first responder group (police, fire, EMS), and effect type (direct, indirect, environmental).

4) Conduct a topic-based scoping review of the collected literature outlining key areas, research gaps, limitations, and potential interventions.

The collected documents were predominantly recent, with 44 percent published in 2020, and 38.7 percent of collected documents were directly focused on the COVID-19 pandemic. Our team collected and reviewed 539 documents. Of these, 83 percent (447) were published in peer-reviewed scholarly journals, 7.1 percent (38) were self-published scholarly works (theses, dissertations, etc.), 3.7 percent were published in trade journals, 2.8 percent (15) were government documents, and 2.6 percent (14) were from NGOs or similar research institutes.

A significant portion of our efforts involved a topic-based scoping review. We reviewed literature on topics that identify the potential environmental, direct, and indirect effects COVID-19 has on first responders. We identified fifteen areas of key interest that related to first responders and COVID-19. These areas involve preparedness, demand for EMS/fire services, demand on crime, occupational exposure, PPE use and availability, staffing, mental health, testing and vaccines, service delivery, public health mandates, communications, deployment, transportation, human resources, and training.

Each of these topics intersect with different environmental, direct, and indirect effects on first responders. We also identified numerous interventions ranging from revised dispatching procedures to the importance of PPE-related refresher training.

This review had a few notable limitations pertaining to the scope, communities of interest, and comprehensiveness. The collection of research ended in early October 2020, and new research will have continued to demonstrate the impact COVID-19 has on first responders. Due to the broad nature of our topic, it limited our ability to review in depth each of the 15 key areas and related sub-topics. Additionally, our research focuses on police, fire, and emergency medical services, and we cannot account for other organizations which must provide services during the pandemic as corrections, security, or emergency departments.

Despite limitations, this document has important key takeaways that will both inform our future research and broader utility to the project. The impact of COVID-19 is multi-dimensional and interconnected. Changes at one level can result in meaningful downstream consequences, which can alter the way first responders make changes to their operations and manage their personnel.

The key findings direct research needs more broadly along three key areas. First, there is a strong need to properly measure the direct effects of COVID-19. Secondly, researchers should better capture the experience of the first responders providing services to the community. Finally, first responder organizations have implemented a variety of interventions and evaluations are needed to identify if they should be considered viable and actionable recommendations for first responders working during a pandemic in the future.

Identifying the key takeaways from collected literature informs our current project and better accounts for gaps in the available research. This review informs our understanding of the research landscape related to COVID-19 and similar events and it will continue to serve as a resource for generating insights, shared understandings, new opportunities, recommendations, and best practices for the first responder community in the future.

Introduction

The ongoing COVID-19 pandemic has imposed human and financial costs on the country's first responders, who risk exposure in their jobs and must maintain operations to ensure the safety of the communities they serve. These first responders are critical stakeholders within the homeland security enterprise (HSE), and their resilience in the face of this pandemic is crucial to the Department of Homeland Security (DHS).

The first responder community includes police, fire, and emergency medical services (EMS). These organizations typically operate at the state, local, tribal, or municipal level and vary significantly in size. Nationwide, there are approximately 18,000 police organizations with nearly 750,000 full-time law enforcement officers (Banks et al., 2016). The National Fire Protection Association indicates there are 1.1 million firefighters and approximately 29,700 fire departments (Evarts & Stein, 2020). Emergency medical services are offered publicly (both as part of and independent from fire departments) and privately. However, less data is available regarding the exact number of Emergency Medical Technicians (EMT) and Emergency Medical Services (EMS) organizations around the country. The National Emergency Medical System reports more than 10,600 EMS agencies reporting EMS activations to their national database (www.NEMSIS.org, Obtained Online, 2020).

The sheer quantity of first responder personnel around the country, the variety of different entities and ways in which they operate, and the decentralized nature of these organizations requires an approach that allows for a detailed understanding of how each entity has been affected by COVID-19. Developing a more detailed understanding of the nature of the organizations will increase the ability to make specific recommendations that are useful to individual organizations in the future.

Given the ongoing nature of the COVID-19 pandemic, this literature review is part of a larger multi-phase project to provide first responders short-term guidance based on the current state of knowledge while offering improved and more in-depth analysis over time.

This document is the final literature review deliverable for this component of the project. In this final document, we outline our literature collection process, the results of that collection, our approach to organizing the collected research, and identify key areas, research needs, and interventions relevant to first responder organizations. The methods outlined here will allow us to identify gaps in available knowledge and identify best practices and lessons learned based on a review of the existing and collected literature.

Literature Review Goals

This review is focused on scholarly research that informs our understanding of how first responder organizations are currently being affected by the COVID-19 pandemic, how they responded to or were impacted by similar events in the past, and how they can provide services during pandemics in the future. It includes research from government and non-government sources, ranging from observational studies that describe the impacts on personnel to evaluations of interventions designed to protect staff or maintain service delivery at the organizational level. The document was also reviewed by subject matter

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experts from the police, fire, and emergency services community to provide additional insight and to identify gaps in collected research.

In this document, we focus on research that is generalizable to the first responder community at large. We sought research that contains a clear methodological approach and have clearly articulated findings.

In this deliverable, we fully explore the collected literature, identify gaps, future research needs, and the collected literature's potential uses.

The goal of this review is to:

1) Provide a thorough and comprehensive explanation of our approach;

2) Report on collected research relevant to COVID-19;

3) Characterize the literature as a whole, areas of concentration, as well as gaps in research; and

4) Identify future research needs and potential uses of the literature collected through this project.

Our focus is on the provision of services during the COVID-19 pandemic, not only in response to the pandemic but also how traditional service delivery and operations are affected by the changing environment. For example, while first responders provide direct care and support in response to the pandemic, they will manage new tasks such as drive-through testing clinics, transport infected patients, or enforce building occupancy, social distancing, mask wearing, and public gathering rules. However, they must also continue to deliver the services they have always provided before the pandemic. The police will still write traffic tickets, firefighters must respond to structure fires, and EMS to car accidents. The pandemic adds an additional layer of complexity and risk to previously provided services.

Approach

This review is based on a systematic approach to evidence-gathering and is grounded in established methods of systematic reviews (Booth, Sutton, & Papaioannou, 2016; Levy & Ellis, 2006; Machi & McEvoy, 2016). Our methods are modeled after the processes seen in Campbell Systematic Reviews and adapted to suit the mission of the DHS to provide a comprehensive understanding of COVID-19, what we know about its effects on first responders, and what we do not.

Collection Approach: Modeling the Campbell Collaboration

Our approach to evidence gathering and synthesis is modeled after the Campbell Collaboration, an organization that focuses on assessing research on the effects of interventions in crime and justice, education, international development, and social welfare. The Campbell Collaboration has an online peer-reviewed monograph series of systematic reviews that follow structured guidelines and standards for efforts under its focus (see https://campbellcollaboration.org). One reason for the Campbell Collaboration's success in identifying "what works" is the requirement that reviews have a strict protocol for collecting, coding, and analyzing information.

In developing our data management plan and coding protocols, we utilized several Campbell Collaboration reviews as templates or models. These include but are not limited to a systematic review on problem-oriented policing (Hinckle et al., 2020), on red light camera interventions (Cohn et al., 2020), and on police legitimacy (Mazerolle et al., 2013).

While several reviews served as a model for our project, it is important to note this current effort is much broader in scope than any of these three models, or indeed most Campbell reviews. We cast a wide net in our search because the nature of the COVID-19 pandemic is continuously emerging, current, and complex, delineating relevant research from non-relevant research is not as straightforward as other reviews. Our approach is designed to allow for the collection and review of hundreds of documents in a relatively efficient and straightforward manner and use the collected research to drive the larger project forward.

Areas of Focus: Short & Long Wave Events

Our approach is framed by the different effects that first responders might face in a crisis scenario. Meehan (2009) identified three effects that pandemic-like events are likely to have on first responders, outlined below:

Environmental Effects: Changes in the operational environment, available resources, work conditions, or the level or type of demand for services. These are unrelated to infected personnel and may impact the quantity and type of service organizations are asked to deliver.

Direct Effects: Illness-driven absenteeism, reduced productivity, and mortality of personnel due to COVID-19.

Indirect Effects: The effects of COVID-19 on operations and the ability to provide services due to a combination of direct and environmental effects (Meehan, 2009).

For example, an EMS provider with 10 ambulances and 50 personnel experienced a 30 percent increase in medical transports (an environmental effect) each week in the first four weeks of the pandemic. Per week, approximately two personnel tested positive for COVID-19 and were quarantined (a direct effect). The reduced number of personnel resulted in a 45 percent increase in response time due to fewer ambulances and available crews (an indirect effect) by the third week. Interventions may occur at any level. Using the prior example, interventions could be made via the call taking system to reduce unnecessary transports, mandate the wearing of increased PPE during transports, or hire additional personnel to ensure adequate staffing levels.

Our focus was on the effect types likely to be associated with COVID-19. However, our review also included similar long-wave and short-wave events that are relevant to first responder organizations (e.g., police, fire, EMS), such as:

- The COVID-19 pandemic, specifically;

- Long-wave infectious disease epidemics (e.g., HIV/AIDS, Ebola, SARS, MERS, etc.) and similar public health emergencies such as influenza; and

- Short-wave events/natural disasters (hurricanes, tornados, etc.).

Long-wave events are those that occur over an extended period (weeks or months) and include epidemics and pandemics; short wave events are those that occur over narrower time periods such as hurricanes or tornados. Studying these recent events allows us to draw more meaningful conclusions and identify evidence-based practices, which have already been subject to intensive study.

Review Scope

Due to broad nature of the collection approach, we limited our scope in a number of ways. We have purposely excluded research related to chemical and biological terrorist attacks and scholarship related to medical ethics and the duty to provide care. While of importance to first responders, counterterrorism efforts tend to be undertaken by specialized groups at all levels of government. The focus of this report is on everyday police, fire, and EMS personnel who must maintain their typical functions and responsibilities within the changing context of the pandemic.

The emergency medical system also includes components and organizations inside and outside the hospital; our focus was on pre-hospital emergency care and transport delivered by emergency medical technicians and paramedics. Literature related to corrections institutions were likewise excluded.

One difficult issue is differentiating between fire and emergency medical service organizations in the collected research, as most fire departments provide some form of emergency medical services. There are also independent emergency medical services separate from firefighting organizations. In most cases, it was not possible to disentangle these in the collected literature, as the original authors do not always distinguish the two. Often times the literature describes emergency medical systems, which is likely inclusive of fire fighter organizations. Due to this overlap, this leaves a potential gap in the collected literature which may be nothing more than an artifact of how researchers described their unit of analysis.

We also excluded from this review non-research guidance to first responder organizations or personnel. Guidance documents are those that explicitly involve describing to practitioners how to do their job (e.g., CDC-authored directives on how to apply PPE or properly sanitize work surfaces). They come from government and non-government organizations. Guidance documents identified in our search process were collected and marked for future use. Some of these guidance documents will aid our formulation of recommendations and best practices in future project deliverables. In a few cases, they are included as a mechanism to highlight research gaps but not in a systematic or formal way.

Data Collection & Coding Methods

For this review, the project team collected, categorized, and organized available literature based on a variety of attributes such as the research design, first responder group, or nature of the short or long wave event being studied. Categorizing the collected literature (to be discussed in more detail later in this

document) allowed us to identify trends and synthesize recommendations and best practices for first responder organizations.

Our collection, coding, and review process had four stages:

1) Collect COVID-relevant research documents and storing these files in an online library (hereafter, the COVID Shared Library).[1]
2) Complete a Secondary Inclusion Check, where the team reviewed collected literature and made a final determination for inclusion for categorization in Stage 3.
3) Categorize collected research based upon various features, such as study type (qualitative, quantitative), first responder group (police, fire, EMS), and effect type (direct, indirect, environmental).
4) Conduct a topic-based scoping review of the collected literature outlining key areas, research gaps, limitations, and potential interventions.

Each stage is explained in greater detail below. Our Codebook is included in Appendix A.

Stage 1: Collection of Documents

Through our collection of documents, we sought to maximize the number of high-quality sources collected and to appropriately target the three different first responder groups (police, fire, EMS). Due to the multiple groups involved and the wide-ranging effects of COVID-19, an extensive keyword search process was required. In this section, we outline the timeframe of collection, databases searched, quality control, search terms, target country, and process.

Timeframe. Our collection of documents began on September 1, 2020 and ended October 1, 2020. We collected COVID-relevant research from 2000-2020. We employed the broad time range of 20 years to leverage research from notable pandemics of this century: HIV/AIDS, SARS, MERS, and EBOLA. The current investigation began on September 1, 2020, approximately six months after the World Health Organization declared COVID-19 a global pandemic.

Databases. Our work leverages various databases, which draw from a wide variety of government, non-government, and academic sources. The seven databases used to search the literature are Google Scholar, Web of Science, Science.gov, PubMed, ProQuest, the National Criminal Justice Reference Service (NCJRS), and ScienceDirect (Elsevier Publications). We selected these databases based on their search algorithms' breadth, prestige, and relative distribution across the research landscape. They have a broad and deep reach into the various repositories of academic literature across many disciplines.

Quality Control. News media, secondary reporting, or social media sources were not collected. We collected only scholarly articles, though these articles range from descriptive studies to surveys to

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[1] Throughout this report we use the term "document," "article," or "research document" to refer to an individual piece of research, such as a journal article.

interventions and evaluations. The primary criterion for inclusion at this stage was relevance to COVID-19 and the first responder community.

Search Terms. When searching each database, the Coders relied upon combinations of search terms to identify research. Only combinations of terms were used to allow us to more quickly and efficiently identify research. We documented each source's search and tracked the start date, phrases searched, and completion date to ensure the collection of all available documents at a given time. A pre-established set of search terms allowed us to identify relevant documents and maximize efficiency in our search.

A full list of search terms is provided in Table 1. Table 1 identifies both primary and secondary search terms. Primary search terms are those specifically related to first responder organizations (e.g., police, EMS), while secondary search terms are descriptors of short and long wave events.[2] Selection of specific key terms was based on available literature collected prior to formal collection and testing of key terms for productivity as part of the research design process. Each primary term was searched in combination with each secondary search term in each of the seven databases. For example, "first responder" and "COVID*" was the first search; "first responder" and "pathogen" the second; "first responder" and "virus" the third. This process was completed for every secondary search term in the set, and then we moved to the next primary search term and began the process again. This would result in 289 searches per database (17 primary terms and 17 secondary terms).

Table 1: Primary and Secondary Search Terms[3]

Primary Search Terms	Secondary Search Terms
First Responder	COVID*
First Responders	Pathogen
Emergency Responder	Virus
Emergency Responders	Epidemic
Public Safety	Pandemic
Police	"Infectious Disease"
Policing	"Corona Virus"
Law Enforcement	Flu
Crime	Influenza
Fire Departments	HIV*
Firefighter	MERS
Fire fighters	SARS
EMS	EBOLA
EMT	Hurricane*
Emergency Medical System	Tornadoes
Emergency Medicine	Blizzards
Emergency Medical Technician	"Personal Protective Equipment" and COVID*

Target Country. Studies were included regardless of the country in which they were conducted or focusing on. However, we only collected and reviewed documents that were available in English.

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[2] Key terms required differentiation into the groups "primary" and "secondary" search terms occur because searching certain combinations such as "virus" and "epidemic" would yield too many unrelated results.

[3] Within the searches we often utilized an asterisks (*) in lieu of all search terms. This asterisk will allow the inclusion of all terms that include the initial term with and without other terms (e.g. when search for "fire*" the search engine will return results for "fire departments, fire fighters, firefighters).

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Process. Project team members (or Coders[4]) performed these searches and made the initial decisions to save documents in the COVID Shared Library. For this selection, the Coder kept any document that met all of the following selection criteria:

1) Related to the impact of long- and short-wave events on first responder organizations;

2) It is considered research (not news or social media, an opinion piece, law review, etc.). Research includes a broad number of methodologies including descriptive studies, experimental design, quasi-experimental design, qualitative interviews, or observational studies;

3) It is a publication in an academic journal (peer or non-peer-reviewed) or a publication from a government or non-governmental research organization; and

4) It describes a direct, indirect, or environmental effect related to a short- or long-wave event of focus or intervention to protect first responders or organizational service delivery.

This selection determination was made based on a review of the search term results. When a relevant document was found, it was saved to the COVID Shared Library, in a folder for that specific search engine, its metadata captured, and, when available, downloaded in PDF format.

Coders first collected relevant research from the online electronic bibliographic databases (Google Scholar, Web of Science, Science.Gov, PubMed, ProQuest, and ScienceDirect). Collection results are outlined in Table 2. Because searches were occurring concurrently and databases often searched the same sources, we removed a significant number of duplicates.

Table 2. Collected Literature by Bibliographic Databases

Search Engine	Initial Search	After De-Duplication
Google Scholar	394	388
NCJRS	75	62
ProQuest	129	115
PubMed	115	113
Science.gov	177	163
Science Direct	104	102
Web of Science	308	233
Total	**1,302**	**1,176**

These documents were then reviewed in Stage 2 for relevance to the project to enable us to more efficiently use available resources.

We also conducted a gray literature search to compliment the search of the seven online databases. This gray literature search involved the review of specific websites and online repositories from non-governmental organizations (NGOs) and similar research entities (e.g., RAND Corp, National Fire Protection Association). We placed additional emphasis on organizations that focus on firefighters due to

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[4] For the purpose of this project, a Coder will refer to a project team member who is responsible for collecting, reviewing, and coding documents.

the reduced number of collected sources related to this group in prior searches. Gray literature sources include:

> **1. EMS -** National Association of State EMS Officials, National Association of Emergency Medical Technicians, The Centre for Evidence Based Medicine.
> **2. Police** - The International Association of Chiefs of Police, the Police Executive Research Forum, and Lexipol.
> **3. Fire -** The International Association of Firefighters, National Fire Protection Association, Firefighter Safety Research Institute, Fire Research Group at NYU, First Responder Center of Excellence, and the International Association of Fire Chiefs.
> 4. **General** – RTI International and Rand Corp.

When searching these websites, we searched each primary term in combination with each secondary term. In comparison to the search of the major bibliographic databases, we limited our search terms to COVID-related as described in Table 3, due to the large number of sources collected. Primary terms included COVID, Corona* and pandemic and secondary terms included Fire*, EMS and Police. These search terms are outlined in Table 3.

Table 3. Search Terms

EMS	Police	Fire
COVID and "First Responder"	COVID and "First Responder"	COVID and "First Responder"
COVID and "Emergency Responder"	COVID and "Emergency Responder"	COVID and "Emergency Responder"
COVID and "Emergency Med*"	COVID and Police	COVID and Firefighter
COVID and EMT	COVID and "Law Enforcement"	COVID and "Fire Department"
COVID and EMS	COVID and "Public Safety"	Pandemic and First Responder
Pandemic and First Responder	Pandemic and First Responder	Pandemic and Firefighter
Pandemic and "Emergency Responder"	Pandemic and "Emergency Responder"	Pandemic and "Emergency Responder"
Pandemic and "Emergency Med*"	Pandemic and Police	Pandemic and "Fire Department"
Pandemic and EMT	Pandemic and "Law Enforcement"	"Corona*" and First Responder
Pandemic and EMS	Pandemic and "Public Safety"	"Corona*" and "Emergency Responder"
Corona* and First Responder	Corona* and First Responder	"Corona*" and Firefighter
Corona* and "Emergency Responder"	Corona* and "Emergency Responder"	"Corona*" and "Fire Department"
Corona* and "Emergency Med*"	Corona* and Police	
Corona* and EMT	Corona* and "Law Enforcement"	
Corona* and EMS	Corona* and "Public Safety"	

Gray literature was selected based on the document's relevance to first responder organizations and COVID-19. When a document met these standards, it was saved to the COVID Shared Library in the "Gray Literature" folder, its metadata captured, and, when available downloaded in PDF format.

While only a limited number of these sources had documents pertaining to COVID-19, many articles did not pertain to first responders, were opinion-based, or were strictly guidance without having a research aspect. A total of 30 sources met our criteria and were collected as a part of our search for gray literature and added to our COVID Shared Library.

Stage 2: The Secondary Inclusion Check

In Stage 2, we had our Coders conduct a secondary check to ensure the document fell within the project's scope. This secondary check ensured that only relevant, high-quality research made its way to the categorization in Stage 3. From the COVID Shared Library, each document was (1) reevaluated for inclusion within the project scope (the Secondary Inclusion Check) by a different Coder, and (2) relevant metadata was updated, again, by a different coder. Duplicates were also removed. This process is fully described in the Codebook in Appendix A.

Secondary Inclusion Check. In the Secondary Inclusion Check, the Coder reviewed the document's keywords, abstract, and title to ensure its relevance to the project. After this review, the Coder made a determination to include or exclude the material using the same criteria as articulated in the initial selection. If excluded, this determination was documented in the COVID Shared Library. A Coder also determined if a document should be considered a guidance document or should be considered of "special" significance to the project. We also had Coders identify (or "tag") whether the document was U.S.-focused to more easily allow us to organize the categorization in Stage 3.

Metadata. In Stage 2, the Coder also verified the metadata for each document tagged for inclusion and ensured it has been accurately recorded in the COVID Shared Library. If the metadata associated with a document did not record properly, it was manually entered by the Coder. We sought to have the following metadata for each source:

- Authors (All)
- Year
- Title
- Journal/Periodical
- Volume & Issue Number
- Pages
- Abstract

Secondary inclusion across the shared library is included in Table 4, which consists of the inclusion by source. Note that documents may have multiple tags (e.g., included, U.S., special, and guidance).

Table 4: Secondary Inclusion by Search Engine

Search Engine	Included	U.S.-Related	Outside-U.S.	Special	Guidance	Exclude
Google Scholar	308	211	98	33	21	86
NCJRS	19	12	1	4	7	43
ProQuest	64	51	14	1	8	53
PubMed	81	68	14	7	4	30
Science.gov	115	65	50	15	21	43
Science Direct	56	39	15	5	4	44
Web of Science	143	104	39	12	10	85
Gray Literature	17	14	3	7	14	10
Total	**803**	**564**	**234**	**84**	**89**	**394**

Stage 3: Categorization

Those documents identified for inclusion were categorized in Stage 3. Our goal in Stage 3 was to organize the collected literature for in-depth examination by the project team. Outcomes associated with the categorization should not be considered an indication of the weight, quality, or significance of any given area of research or topic.

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Categorization Process. Coders reviewed each document and categorized it using the Qualtrics survey outlined in Appendix B. During categorization, the Coder answered a series of questions for each document. These questions are summarized in Table 5 below, fully defined in the Codebook in Appendix A, and displayed via the categorization instrument in Appendix B.

Table 5: Categorization Measures

Variable	Description	Choices
Coder	By name	Coder name
APA Citation	A reference generated by Zotero	NA/Text
Year Published	Year of publication	Numeric Entry
Publication Type	Type of publication	Peer-reviewed, practitioner/trade journal, government report, NGO, self-published, other.
Responder Group	Relevant first responder group	Police, Fire, EMS, Other.
Country	Country of relevance or focus to the research document.	U.S., Five Eyes Nation, Outside Five Eyes, Multi-national
Data Collection	Involve new data collection or the analysis of existing data	Collected New, Analyzed Existing
Data Type	Type of data that best describes the collected and analyzed data.	Qualitative, Quantitative, Both
Study Type	Overall analytical approach.	Theoretical conceptualization, focus groups or interviews, analyze survey or poll, analyze existing agency records, or literature review
Evaluation	Involved an evaluation performed	Yes, No
Evaluation Type	Type of evaluation	Impact, Process
Evaluation Name	Describe the evaluated program	Text
Eval 1st or 3rd	They evaluated their own or someone else's program.	Own, Someone Else's
Intervention	Involve an intervention	Yes/No
Intervention Type	Type of intervention	Environmental, Direct, Indirect, Other
Intervention	Describe the intervention.	Text
Event	Identify the type of long/short wave event the research involved	COVID-19, Natural Disaster, Infectious Disease, General Injury, Other
Natural Disaster Detail	Identify the type of natural disaster	Blizzard, Tornado, Hurricane, Fire, Other
Infectious Disease Detail	Identify the type of infectious disease.	Ebola, HIV/AIDS, SARS, MERS, Flu, Other
Event Name	Identify named disaster	Text
Unit of Analysis	General unit of analysis of the study	Individuals, Incidents, Organizations, States, Nations, Multi
Major Findings	Identify major findings	Text
Effect Type	Identify the effect type	Environmental, Direct, Indirect
Topic	Identify the general topic	See Table 5
Relevance	Coders view on the overall relevance of the document.	1 to 5 stars.

As part of the study, we asked Coders to identify primary and secondary topics that best describe each specific document. A list of these topics is included in Table 6 below. Reviewers could also include additional relevant issues by selecting "Other" and using text entry to identify a topic.

Table 6. List of Topics for Categorization

Staffing	Service Delivery	Training	Mental Health/Well-being
Deployment	Policy	Technology	Physical health

Demand	Human Resources	Testing	Enforcement or compliance with public health mandates
Availability of PPE	Financial Costs	Productivity	Transportation
Use of PPE	Communication	Public Reaction	Occupational Exposure

To allow the Coders to approach the categorization in stages, we identified all research focused on the United States first, then moved to documents that involved research outside the United States.

Stage 3: Categorization Results

In this section, we describe our results of the categorization process, which is inclusive of all collected literature. Due to the way Zotero stores duplicate sources across folders, the number of documents that were ultimately categorized in Stage 3 is lower than what was collected when looking at all search engine sources and databases.[5]

Collected Documents. Our team categorized 539 unique documents. Of these, 83 percent (447) were published in peer-reviewed scholarly journals, 7.1 percent (38) were self-published scholarly works (Master's thesis, dissertations, etc.), 3.7 perfect were published in trade journals, 2.8 percent (15) were government documents, and 2.6 percent (14) were from NGOs or similar research institutes. The tables and figures in this section present descriptive statistics based on these 539 documents in an effort to characterize collected research related to how COVID-19 is affecting first responders. The project team reviewed each document and coded it along each of the attributes outlined in Table 5.

Events Studies and Year of Publication. The collected documents were predominantly recent, with 44 percent published in 2020. While our search included crisis scenarios similar to COVID-19 (natural disasters, previous epidemics), 38.7 percent of collected documents were directly focused on the COVID-19 pandemic. Other infectious disease outbreaks were the focus of 30 percent of documents, while 19.6 percent studied natural disasters.

Figure 1 displays the collected documents based on year of publication. The large number of documents from 2020 reflects our effort to ensure that we collected research specific to COVID-19. The collected research spanned all three first responder groups (see Table 7), with some pieces of research relevant to multiple groups (e.g., fire and EMS).

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[5] For example, a single document may be been collected via four search engines and reside in multiple locations in our research library. While Zotero allows us to merge this document into a single underlying case it is still represented in each individual location.

Figure 1: Documents Categorized by Publication Year (N=539)
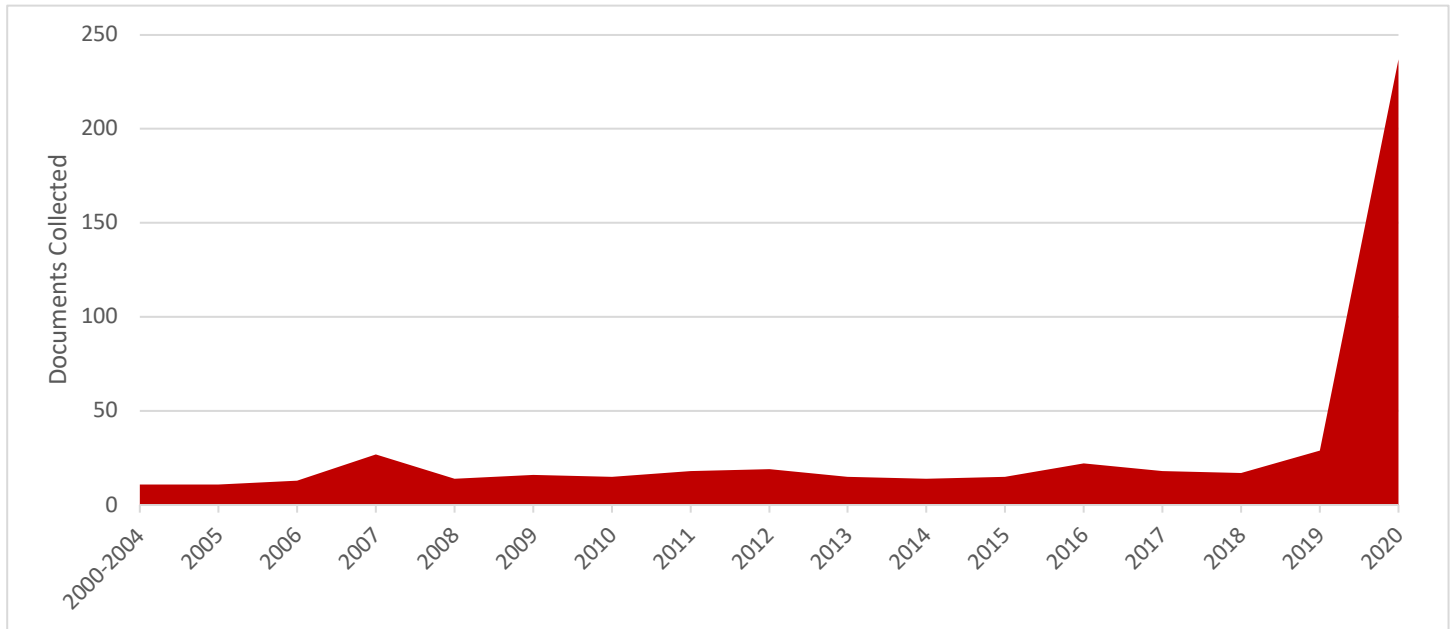
First Responder Groups. Our review encompassed law enforcement, fire, and EMS organizations. Although there does appear to be less research available on firefighters compared to law enforcement and EMS personnel, this may have more to do with the overlap between the provisional emergency medical services and firefighting organizations. Table 7 presents the total number of collected documents that pertain to each group and highlights the number of COVID-specific research documents for each responder group.

Table 7: Number of Documents Related to Each First Responder Group

Responder Group by Number Coded (% out of N=539)	Total Number of Documents Coded	Number of COVID-Specific Documents Coded
Police	256 (47.5%)	106 (19.6%)
Fire	124 (23.1%)	35 (6.5%)
EMS	310 (57.5%)	118 (21.9%)

First Responder Group by Event Type. Table 8 describes all documents based on first responder group (police, fire, EMS) and event type (e.g., COVID-19, natural disaster, or other infectious disease). Each area of research provides an opportunity to identify the effects of COVID-19 on first responders for future study, and also to understand and construct novel strategies for protecting personnel and maintaining service delivery.

Table 8: First Responder Group by Event Type[6]

Group by Event	COVID-19	Natural Disaster	Other Infectious Disease	Injury	Other
Police	106	72	56	10	12
Fire	35	30	32	14	13
EMS	118	48	107	17	20
Total*	**209**	**106**	**162**	**29**	**33**

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[6] Summing across the bottom row of this table will add up to 539, which is the total number of documents coded. However, because each document may be tagged as relevant to more than one first responder group, the columns in this table, summing down, will add up to a number greater than the totals presented at the bottom of each column.

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Research Designs. Collected documents varied significantly in their research design. Some included qualitative data (24.1%), more included quantitative data (33.4%), and some included a mix of both quantitative and qualitative data (18.9%). Regretfully, a limited number of documents involved an evaluation of some kind (20.8%). Of the 209 COVID-specific documents, 24 included an evaluation (11.5%) and 15 (7.2%) studied a formal programmatic intervention.

Evaluations and interventions provide organizations an opportunity to harness evidence-based methods that may be of use in the near-term as first responders share information, pilot new technologies, and adapt to novel working conditions. Understandably, studies of this kind can take more time and energy to produce, compared to studies that employ other methodologies (e.g., surveys), and this may explain why they appear scarce in the COVID-specific literature. Wherever possible, we sought to incorporate evaluations and interventions in our topic-based scoping review described in the next section.

Table 9 provides an overview of the different methodological approaches encountered for each event type (COVID-19, natural disaster, infectious disease, general injury/other.).

Table 9: Research Design by Event

Research Design	COVID-19	Natural Disaster	Infectious Disease	General Injury or Other	Total
Theoretical Conceptualization	62	17	17	5	101
Literature Review/Meta-Analysis	19	16	15	9	59
Survey Research	27	24	55	24	130
Analysis of Agency Records	77	34	35	12	158
Interviews/Focus Groups	10	12	15	8	45
Other	14	3	25	4	46

As Table 9 indicates, a sizeable number of documents involved surveys (24.1%) and analyses of agency records (29.3%). Within the realm of COVID-specific research, analyses of agency records and theoretical conceptualizations were the two most common designs encountered; this is likely a product of reviewing the literature on a subject that has been in the public eye for only a matter of months. There is also a dearth of interviews and focus groups related to COVID-19.

When reviewing these findings across Tables 9, a considerable number of research designs are described as "theoretical conceptualizations" (101 of 539, or 18.7%). While these documents offer some utility and can direct the readers' attention toward new or important points, they typically do not involve traditional data collection and generally consist of an author describing a topic conceptually, making a call to action, or offering recommendations. Broadly speaking, we found documents that employ other design types— meta-analyses, survey work, analyses of agency records, or in-depth interviews or focus groups—to be of greater benefit in understanding the challenges first responders face. In-depth interviews do not appear common, especially within the COVID-specific literature, and therefore represent an area worthy of future research that will be highlighted in the next section.

Effect Types. An important aim of our work has been to categorize COVID-related research as it pertains to the environmental, direct, or indirect effects. Because some complex studies contain multiple areas of focus, any given document may relate to more than one effect type. For example, a study of PPE use may

address the direct effects of first responders being exposed to the virus, as well as the indirect effects of how organizations' response times change due to additional safety protocols tied to donning PPE while responding to a call or the time and material costs associated with decontaminating vehicles.

Looking at the full set of 539 collected documents, we categorized 49.9 percent of this literature as relating to environmental effects, 47.3 percent as applicable to direct effects, and 42.8 percent as related to indirect effects. A considerable percentage of documents on environmental effects examined the impact of COVID-19 on fluctuating crime rates. Crime is an important outcome variable and can be of relevance to both police and emergency medical services and will be discussed in greater detail in the next section.

Table 10 presents frequencies for all documents collected based on the first responder group (police, fire, EMS) and effect type (environmental, direct, indirect). Note that many documents cover multiple responder groups or effect types, and therefore individual cells in this table will add up to a number greater than each row. Percentages are based on dividing the number of documents that meet each of the two criteria (e.g., police and environmental effects, 135) by the total number of documents coded (539).

Table 10: First Responder Group by Effect Type

Group by Effect Type	Environmental	Direct	Indirect	*Total*
Police	135 (25.1%)	112 (20.8%)	91 (16.8%)	**256**
Fire	33 (6.1%)	92 (17.1%)	45 (8.3%)	**124**
EMS	163 (30.2%)	144 (26.7%)	138 (25.6%)	**310**
Total	**269**	**231**	**255**	**539**

Topic Areas. A part of the categorization effort involved identifying each document by topic (e.g., communication, human resources, service delivery, occupational exposure, mental health, etc.). Table 11 overviews these topic categorizations. Tables related to topic areas are presented in alphabetical order.

Each document may have multiple primary topics and multiple secondary topics. For example, a study on how state-level mandates related to donning PPE during service delivery may slow EMTs response time to a call may have primary topic tags of "PPE Use/Availability," and "Deployment" and secondary topic tags of "Public Health Mandates" and "Service Delivery."

Table 11: Overview of Topics

Topic	Total	Primary	Secondary
Communication	75	24	51
Demand	220	172	48
Deployment	91	56	35
Human Resources, Policy, and Financial Concerns	272	115	157
Mental Health and Well-Being	86	58	28
Occupational Exposure and Physical Health	384	218	166
PPE Use and Availability	194	113	81
Preparedness	210	112	98
Public Health Mandates	112	53	59
Service Delivery and Productivity	246	112	134
Staffing	87	45	42
Technology	66	31	35

Testing and Vaccines	84	43	41
Training	157	79	78
Transportation	50	23	27

As Table 11 indicates, the most frequently observed topics were Human Resources, Policy, Financial Concerns. Occupational Exposure and Physical Health, Service Delivery and Productivity, Demand for Services, and Preparedness.

In Table 12 and Table 13, the analyses are based on primary topic tags only (as these are of higher salience and reliability than secondary topic tags) in order to provide a clear picture of the variety of studies encountered in our collection and review. Table 12 organizes these categorizations by first responder group, and Table 13 displays topics as a function of event type (COVID-19, natural disaster, infectious disease).

However, viewing primary topic categorizations by responder group (Table 12) and event type (Table 13) helps clarify with a greater degree of specificity areas of the literature that have received special focus, and areas in need of future research.

Table 12: Primary Topics Covered by First Responder Group

Primary Topic By Responder Group	Total	Police	Fire	EMS
Communication	24	15	6	10
Demand	172	100	12	102
Deployment	56	27	9	30
Human Resources, Policy, and Financial Concerns	115	68	33	57
Mental Health and Well-Being	58	39	22	22
Occupational Exposure and Physical Health	218	84	95	138
PPE Use and Availability	113	27	31	80
Preparedness	112	41	21	68
Public Health Mandates	53	33	3	16
Service Delivery and Productivity	112	37	19	77
Staffing	45	24	14	25
Technology	31	12	3	20
Testing and Vaccines	43	12	15	31
Training	79	28	13	51
Transportation	23	4	3	21

Table 13 describes the primary topic by event type. There were a large number of studies related to COVID-19 service delivery (N=45), COVID-related demand (N=99) and non-COVID-related demand (N=52) and occupational exposure and physical health related to COVID-19 (N=48), human resources, policy, and financial concerns (115), and other infectious diseases (117).

Table 13: Primary Topics by Event Type

Primary Topic By Event Type	COVID-19	Natural Disaster	Other Infectious Disease	General Injury or Other
Communication	3	13	5	3
Demand	99	52	18	3
Deployment	15	24	12	5
Human Resources, Policy, and Financial Concerns	36	28	42	9

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Mental Health and Well-Being	20	22	5	11
Occupational Exposure and Physical Health	48	20	117	33
PPE Use and Availability	39	1	36	37
Preparedness	28	30	38	16
Public Health Mandates	24	19	8	2
Service Delivery and Productivity	45	31	26	10
Staffing	11	15	11	8
Technology	10	8	8	5
Testing and Vaccines	16	1	24	2
Training	48	20	117	33
Transportation	13	5	5	0

As Table 13 indicates, demand for service is the topic that has received the most attention within the COVID-19 literature and in the literature on natural disasters. It is apparent there is a large number of studies that measured the impact of Hurricane Katrina on crime in and around Louisiana and Texas following the 2005 disaster and on COVID-19 and crime trends during the pandemic.

Overall, the topics of demand, human resources, policy, and financial concerns, occupational exposure and physical health, and service delivery represented major areas of focus. There are multiple studies related to occupational exposure and physical health of first responders, which remain critical to the study of direct impacts of COVID-19, given the virulent nature of this virus in particular. Service delivery, which has been altered in myriad ways as first responders adjust their operations to accommodate COVID-related concerns, also represents a major area of study, and work on this topic is also of relevance to evidence-based guidance and related publications that help first responders adjust to the changing nature of their work.

During this categorization process, team members also rated the relevance of document to the overall aims of the project on a 5-point scale. Of the 539 documents coded, 22.6 percent received a 5-star rating (denoting very high relevance to the overall project), 34.8 percent received a 4-star rating, 28.2 percent received a 3-star rating, 11.9 percent 2-star, and 2.4 percent received a 1-star rating (denoting lowest relevance). While these ratings were subjective, they were of use to the project team when conducting the in-depth topic-based scoping review quickly identify potentially key documents.

This categorization process serves as a vehicle for the continued analysis of the collected documents, the interpretation of the data collected for other components of this project and as a mechanism for identifying evidence-based approaches that can make first responder organizations more resilient to COVID-19 and future pandemics.

Stage 4: Topic-Based Scoping Review

The fourth stage of our literature review involved a topic-based scoping review to explore the key concepts, gaps in research, and interventions of potential relevance to our current project specifically and first responders more generally. Due to the volume of research collected, we took a systematic approach to reviewing the findings associated with each topic. Each topic was assigned to a project team member who was responsible for conducting a limited review of the topic's categorization data, identifying key themes and concepts, identifying a subset of articles that capture these key themes, reviewing those

documents in full, creating an outline, then drafting the topic-based review. Each topic was subject to numerous peer reviews to ensure comprehensiveness and fidelity with the overall project.

As part of our review, we identified numerous subtopics that capture different aspects of how COVID-19 is affecting first responders. For example, our review encompassed both physical and mental health of first responders, and the literature on mental health specifically identified numerous areas of study, including compassion fatigue, PTSD, resilience, and social isolation. This is outlined in Section VII (Mental Health). We also found consistent themes across topics. For example, the provision of PPE-related training outlined in Section XV (Training) can contribute to personnel's willingness to come to work described in Section XIV (Human Resources). Works cited are also included topically to allow for easier follow-up by readers.[7]

In total, we identified fifteen topics that were the focus of our scoping review. They include:

I. Preparedness

II. Demand for Services: EMS & Fire

III. Demand for Services: Crime

IV. Occupational Exposure and Physical Health

V. PPE Use and Availability

VI. Staffing

VII. Mental Health

VIII. Testing and Vaccines

IX. Service Delivery and Productivity

X. Public Health Mandates

XI. Communications

XII. Factors Impacting Deployment

XIII. Transportation

XIV. Human Resources

XV. Training

While some variation may occur, each topic section is outlined similarly. Each section includes an introduction to the topic, then key and consistent findings, followed by discussions of research design and limitations, interventions, and then needed research. We first explore the most proximate issues that first responders and first responder organizations face (e.g., preparedness, crime, demand for services, exposure to COVID-19), and then we gradually transition to a discussion of longer-term topics (e.g., mental health, communications, human resources and financial impacts, and training).

I. Preparedness

Preparedness is directly relevant to an organization's ability to function in the face of a natural disaster or pandemic and meet the combined environmental, direct, and indirect effects on their organization and ability to provide services. Preparedness relates to the ongoing cycle of organizing, training, equipping, and exercising to ensure an effective response to a natural disaster or pandemic. It generally requires formal procedures and guidelines when not dealing with an adverse event (Belfroid et al., 2017). While preparedness is typically driven by decisions and funding at the state and national level, in the end,

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[7] It was necessary to combine various topics due to the overlap if identified topics did not have enough consistent or relevant research to construct a usable narrative. Specifically, productivity was merged into service delivery, technology was merged into each topic when it applied to a relevant intervention, and the "other" topic did not have enough consistent research outside of the other topics to require a full scoping review.

individual first responder organizations have the responsibility of being prepared to respond to a pandemic or natural disaster.

This section is informed by preparedness literature across first responder organizations at the national level. The consistent message across the literature is that preparedness can help an organization respond, but any response during a natural disaster or pandemic will require adjustments based on emerging needs and requirements. Preparedness is also a rationale for training (Section XV), vaccination plans and approaches (Section VIII), human resources (Section XIV), and maintaining the mental health of personnel (Section VII).

More recent literature related to levels of preparedness for a pandemic is scarce. It is unknown if lack of preparedness within first responder organizations was an issue at the start of the COVID0-19 pandemic. Therefore, our focus here is not to identify the extent to which first responder organizations were or were not prepared. Instead, we emphasize the elements associated with preparedness at various levels and the need for review and assessment of the preparedness plans by first responder organizations.

Key and Consistent Findings

A lack of disaster planning among first responder organizations is a recognized concern by researchers and U.S. government organizations (FICEMS, 2009; Furbee et al., 2006; Laufs & Waseem, 2020; Mahomed et al., 2007). However, this research is generally dated. A 2009 assessment of state EMS systems found that EMS and 9-1-1 systems preparedness for pandemic influenza was "generally inadequate" (FICEMS, 2009, p. 1). Maguire et al. (2007) found that most EMS agencies in a sample of Maryland organizations did not have comprehensive or formal response plans to cope with pandemic events. In a survey of rural EMS organizations, Furbee et al. (2006) found perceived concern regarding preparedness to deal with events involving large numbers of victims in need of assistance.

Available research identifying preparedness planning related to COVID-19 is minimal. Lum et al. (2020A) report that 83 percent of organizations provided personnel with formal training on the prevention of infection, and 76 percent had at least a month's worth of PPE available (p. 1). Lum et al. (2020A) did not include questions about formal preparedness plans in their study. In a 2018 to 2019 survey of EMS personnel, only 14.3 percent report participating in a pandemic training exercise - indicating that preparedness may be an ongoing issue (Rebmann et al., 2020, p. 601).

Community-level first responder organizations operate amongst a web of other local, state, and international organizations, rules, and mandates. National preparedness may both fund and provide an impetus for local organizational preparedness. A variety of federal organizations, including the Federal Emergency Management Agency, are involved in preparing first responder organizations for natural disasters. For example, the National Incident Management System (NIMS) provides vocabulary, systems, and processes for how operational systems and personnel work during incidents (https://www.fema.gov/emergency-managers/nims, Obtained Online, December 17, 2020).

The national response to Ebola provides one example of how national preparedness can drive local preparedness. During the Ebola pandemic, national and regional preparedness involved the early

identification of travelers who may have been infected or exposed, the creation of a system of tiered responses for hospital readiness, establishing Ebola response teams, developing guidance for EMS systems and 9-1-1 systems related to Ebola, and establishing procedures for waste management (Van Beneden et al., 2016). Through the Temporary Epidemiology Field Assignee (TEFA) program, the CDC also assigned personnel to assist state and local jurisdictions in responding to Ebola (Caceres et al., 2019). These individuals supported epidemiology and surveillance, health communications, and health system preparedness for high consequence pathogens (Caceres et al., 2019).

At the organizational level, preparedness takes many forms. In a study of recommendations of first responder preparedness experts, Belfroid et al. (2017) identified several critical areas of outbreak preparedness for health care first responders: drafting and maintenance of preparedness plans, establishing mechanisms to support health professionals and their families, making provision for surge capacity, communications planning, coordination and collaboration with other organizations, and exercising plans. These also generally align with recommendations from the Bureau of Justice Assistance for law enforcement organizations dealing with pandemics (Richards et al., 2006).

While dated, the potential need for organizational-level planning and preparedness is exemplified in Maguire et al.'s study of EMS preparedness in the state of Maryland. Of responding EMS organizations, only 34.7 percent had a plan if there were more sick calls than available ambulances, but most of the plans involved a reliance on mutual aid (Maguire et al., 2007). During a pandemic, mutual aid may not be available. Only a single agency had a plan for preventing ambulances from being stuck waiting when a hospital is full and unable to unload patients (Maguire et al., 2007). In either case, unless approaches are developed to mitigate these issues, it could result in delays in service delivery.

Preparedness Plans. Plans are a vital component of preparedness. These plans describe roles, functions, processes, contingency plans, and guidelines organizations will implement during a pandemic or natural disaster. While we reference them in this section, emergency preparedness and response planning are broad areas, and it is outside our ability to review all literature on the topic entirely.

Preparedness plans outline local, state, and federal organizations' responsibilities during events and include guidelines for active monitoring, laboratory diagnosis, contact follow-up, patient isolation, transport of patients under investigation, and collaboration between stakeholders. Plans may also have triage protocols at multiple levels, including by community members to keep them from using the medical system when not needed, triaging at phone banks, EMS personnel at the time of transport, and the hospital system itself (Sanchez & Adams, 2007). Plans should account for the repeated impact of a pandemic on organizations over a long period and the likelihood of this impact occurring in waves (Laufs and Waseem, 2020; Richards et al., 2006). These plans should also focus on the earlier phases of a pandemic when a vaccine and other treatments are generally unavailable (Santos-Presciado et al., 2009) and should include formal and informal collaboration with other organizations (Belfroid et al., 2020; Laufs & Waseem, 2020).

O'Sullivan et al. 2007 identified three plan components: informational, instrumental, and emotional supports. Informational supports involve activities involving disseminating information in pre-disaster

planning (O'Sullivan et al., 2007). Informational supports include clarification of worker roles, disease surveillance, policies and priorities related to anti-viral and vaccines, and disseminating educational materials. Instrumental supports include tangible aid to protect workers from exposure and enable them to perform their work during a disaster (O'Sullivan et al., 2007). These instrumental supports include the provision of PPE, mobilization of personnel, plans for dealing with insufficient resources (equipment and personnel), screening for potentially infected personnel, and job protections for those who become ill at work. Emotional supports also included counseling for staff, providing family care, allowing the use of more precautionary measures, and establishing mechanisms to identify vulnerable workers (O'Sullivan et al., 2007).

Training was considered both informational and instrumental and involved training in the use of PPE, to complete unfamiliar tasks, and readiness exercises (O'Sullivan et al., 2007). Training should be focused on infection control measures, prevention and education programs, and the identification of dedicated staff related to human resources. The benefits of training also impact not just organizational preparedness. It has various benefits to organizations and first responder personnel, which is more fully discussed in Section XV (Training).

Surge Capacity. An essential component of preparedness plans is addressing surge capacity and ensuring that personnel are available to meet demand. Preparing for staffing shortages is a recognized concern across the literature (Laufs & Waseem, 2020; Manley et al., 2006). Furbee et al. (2006) report that 70 percent of rural EMS organizations who responded would be overwhelmed if five or more patients needed help concurrently (p. 65). Manley et al. (2006) report a similar concern with a lack of surge capacity in rural hospital systems. As part of an emergency plan, surge capacity allows organizations to plan on how to leverage all available human resources from the standard labor pool and non-standard labor pools such as retirees, students, and personnel from other health disciplines (O'Sullivan, 2007) such as home healthcare workers (Ross & Bing, 2007). Surge capacity also allows organizations to limit excessive workload on personnel and can protect their health and safety over the long term.

Mission Adaptation. While the first responder organizations have various missions, researchers recommend police organizations also plan for their role in ensuring compliance with public health mandates, orienting their personnel to recognize their changing role, and accounting for psychological health and wellbeing (Laufs & Waseem, 2020). Mann and Williams (2020) identified additional planning factors that could be taken into account associated with the response to Hurricane Harvey in Texas. They identified several areas related to disaster planning and response, including making sure that law enforcement personnel are aware of potential changes in command, task priorities, fluctuation of duties, recalls of personnel, how to utilize volunteers, and an understanding that normal tasks may be delayed (Mann & Williams, 2020). Mann and Williams (2020) also identified issues related to coordination between all levels of government (local, state, and Federal) and the need to plan the integration of volunteers, private industry, and not-for-profits into a response.

There is also a consensus among the literature that despite preparedness planning, there needs to be flexibility to deal with emerging situations during a disaster event (Adams & Stewart, 2015; Laufs &

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Waseem, 2020, Mason et al., 2017). Even with the establishment and implementation of a preparedness plan, an event may still overwhelm an organization, as was seen with the New Orleans Police Department (NOPD) during Hurricane Katrina. Adams and Stewart (2015) report that the NOPD hurricane plan had been implemented multiple times previously with success but failed due to the extreme circumstances associated with Katrina. Lastly, if an organization had to trigger a preparedness plan, there needs to be a follow-up of the lessons learned from the event, and the plan needs to be updated to account for those lessons learned (Adams & Stewart, 2015).

Preparedness & Concurrent Disasters. One area of concern identified in the literature is the need to prepare for concurrent disasters. Concurrent disasters involve simultaneous occurrence of two or more disaster events at the same time (Janzwood, 2020). In the COVID-19 pandemic, we have seen concurrent disasters with the western United States' wildland fires and the threat of hurricanes along the East coast (Janzwood, 2020). As part of preparedness for concurrent disasters, planners must consider the needed response (such as evacuations) while mitigating the potential spread associated with COVID-19. In an evacuation during the current COVID-19 pandemic, this could include planning for the use of private and smaller vehicles for evacuations, prioritizing testing for those traveling on buses or airplanes, or the use of smaller spaces (such as hotels) instead of larger shelters where social distancing is more difficult (Janzwood, 2020; Roman, 2020). It could also include the use of virtual networks for aid workers and the provision of mental health counseling and medical checkups (Roman, 2020).

Limitations and Needed Research

As EMS organizations are central to the community-level response, their preparedness is of national importance. In a review of EMS system preparedness, FICEMS (2009) outlined several areas of preparedness needed for state-level EMS systems to respond to an influenza pandemic, which has important parallels to the current COVID-19 pandemic. FICEMS (2009) identified several concerning gaps in the preparedness of EMS systems, including the need for better integration with other preparedness planning efforts, ensuring the availability of appropriate PPE, medical oversight of EMS and 9-1-1 systems, integration of EMS systems with community mitigation efforts, and the need for improved continuity of operations and surge capacity.

FICEMS (2009) identified two areas for improvement regarding EMS and 9-1-1. The first involved ensuring EMS systems have plans to integrate with national-level planning, maintain continuity of operations, establish legal authority, clinical standards and treatment, and workforce protection. The second area includes integrating the 9-1-1 Public Safety Answering Points (PSAPs) into planning, including providing information to the public, call screening, priority dispatch, education and training of PSAP personnel, and continuity of operations (FICEMS, 2009).

Nearly every first responder organization is currently dealing with the COVID-19 pandemic. Most of the collected preparedness research is focused on the emergency medical system, and less work is available on fire and police. We do not know the extent of each organization's preparation for pandemics in terms of their planning, training, storage, and PPE provision. Future research should work with first responder organizations to identify the extent of their preparation and planning, how/if these plans were effective

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in the early stages of the COVID-19 outbreak, and how concurrent disasters were planned for and addressed. We encourage the updating of these plans based on lessons learned from the current pandemic and by looking to evidence-based interventions conducted by other organizations, researchers, governments, or NGOs studying COVID-19.

II. Demand for Services: EMS and Fire

Any increase in demand for EMS and fire departments during the pandemic is of critical concern to national security because these are the individuals likely to be providing direct care to persons infected with COVID-19. Changes in demand impact several other factors of first responders' jobs, such as response capabilities, exposure to disease, and mental health issues or fatigue. Therefore, reviewing literature assessing how demand has changed during the pandemic can yield important insights into not only environmental but also indirect and direct effects associated with COVID-19.

It is crucial to distinguish demand from the response. Demand focuses on requests for service by the community. Response efforts focus on how responders act once they receive a request for service. This section will focus on describing demand, as the response to community demands is described in Section XII (Factors Impacting Deployment) and in Section IX (Service Delivery and Productivity).

We describe EMS and fire demand separately from crime due to their substantive difference and the volume of literature related to crime and the lack of clear and consistent findings. The impact of COVID-19 on crime is described in more detail in Section III (Demand for Services: Crime).

In the collected literature, it was difficult to disentangle the overlap between firefighters and EMS work. The way each organization responds to service requests can vary at the community level; sometimes, firefighters are the first responders to medical calls, and EMS serves as a transport function only. In others, it depends on the severity of the call. Because it was not possible to separate these two, this leaves a lack of research-focused on specific fire demand separate from EMS.

Key & Consistent Findings

When assessing for changes in demand, most researchers analyzed data from 9-1-1 call centers or published data from dispatch centers (Fagoni et al., 2020; Friedman & Stayer, 2020; Jaffe et al., June 2020; Lerner et al., 2020; Lersch, 2020; Slavova et al., 2020). Changes in call volume were a frequent measurement tool to determine how demand changed due to COVID-19. Across the collected literature, they found increases in calls related explicitly to COVID (Friedman & Stayer, 2020; Jaffe et al., 2020B), increases in calls for mental health and opioid concerns (Lersch, 2020), and increases in calls for panic and miscommunications about the pandemic (Semeraro et al., 2020). However, certain types of demand for EMS services fell (Lerner et al., 2020). Each will be described in more detail below.

Increase in COVID-related Calls. Collected research found increased demand for care in COVID-related situations (Fagoni et al., 2020; Friedman & Stayer, 2020; Jaffe et al.,2020A; Jaffe et al., 2020B). Domestically, the New York City 9-1-1 system recorded a 40 percent increase in calls by April 2020 due to COVID (Friedman & Stayer, 2020, p. 797). In Israel, 8.51 percent of all daily calls were COVID-related

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(Jaffe et al., 2020A, p. 410), with most calls about COVID symptoms such as cough, fever, and throat pain (Jaffe et al., 2020B, p. 3).

This increase in demand also had an impact on patients. The rise in COVID cases and the rise in patient illness led to increases in patient deaths. Fagoni et al. (2020) found in Italy that the increase in EMS patient demand included a 246 percent increase in patient death and a 481 percent increase in patients not transported to the hospital for their symptoms (p. 3). The increase in call volume and patient demand in a prehospital context during the COVID pandemic has overwhelmed dispatch centers, leading patients' demands unmet (Fagoni et al., 2020; Friedman & Stayer, 2020).

Increase in Calls for Mental Health and Opioids. Increased mental health calls and opioid calls should be expected as quarantines and stay-at-home orders take a psychological toll on the public (Lersch, 2020). Data gathered from the Detroit Police Department between February 26 and April 27 found that EMS calls for mental health concerns only slightly increased as COVID cases increased (Lersch, 2020, p. 8). However, this may be a limited study as the time frame is short and is early in the pandemic. Separately, opioid overdoses and calls for EMS are increasing during COVID. For example, between January 14 and April 16, EMS calls for opioid overdoses increased by 17 percent, and the same time period showed a 50 percent increase in opioid overdoses resulting in on-sight deaths (Slavova et al., 2020, p. 1). The study predicts that EMS demand for opioid overdoses will remain at higher levels as the pandemic continues (Slavova et al., 2020).

Increase in Non-emergency Calls. Calls regarding COVID misinformation and panic have been a concern among emergency dispatch. A study in the Emilia Romagna Region of Italy addressed the panic that the community felt following the first reported COVID case, which resulted in increased call volume to the EMS dispatch center (Marrazzo et al., 2020). In the three days after the first reported COVID case, calls to the dispatch center tripled as the public responded in a panic (Semeraro et al., 2020, p. 1). This issue is more fully described in Section IX (Service Delivery and Productivity).

Decreased Demand for Certain Conditions. While EMS demand increased in terms of calls for COVID-related services, mental health and opioids, and public panic, call volume for certain services decreased. Between the 10th and 16th week of 2020, the National EMS Database repository data showed a decrease in EMS call volume by 26.1 percent (Lerner et al., 2020, p. 695). Declines in EMS calls for service are associated with stay-at-home orders. EMS demand for calls such as car accidents, general injuries, head injuries, limb injuries, cardiovascular issues, and pneumonia all decreased in the early months of 2020 (Jaffe et al., 2020B; Lerner et al., 2020). This decrease in certain types of calls can allow EMS workers to reassess their distribution of resources during times of crisis and better predict how their services will be utilized.

Fire Prevention Activities. Alternatively, COVID-19 may have limited wildland firefighter ability to conduct preventive activities, resulting in increased threat from fires in the future. Stoof et al. (2020) identified a concern that COVID-19 will impact risk reduction activities and other research showing that fire risks can increase after natural disasters when preventative actions are not pursued (p. 3). Bryant and Boykin (2007) also emphasize that natural disasters can prevent the removal of debris and fire-

related materials, thereby increasing the risks that fires could increase following a natural disaster (p. 291).

Research Designs & Limitations

When assessing demand, call volume tends to be the most consistently used metric. Nearly every study compiled in this literature review gathered call data from dispatch centers, 9-1-1 call centers, or a national database of EMS calls (Fagoni et al., 2020; Friedman & Stayer, 2020; Jaffe et al., 2020A; Jaffe et al., 2020B; Lersch, 2020; Slavova et al., 2020). The only point of deviance in assessing call volume was whether researchers gathered this data from a singular metropolitan area (Lersch, 2020), an entire region (Semeraro et al., 2020), or at the national level (Lerner et al., 2020; Jaffe et al., 2020B).

Interventions

A number of interventions to account for EMS and fire demand changes during COVID-19 were identified through the collected literature. Researchers frequently recommend restructuring EMS response mechanisms to effectively triage the calls for service and improve reallocation of resources (Jaffe et al., 2020A; Jensen et al., 2020; Schull et al., 2004). Diverting resources to address the demand may improve patient care, especially for situations where patient deaths are increasing. These changes and restructuring of EMS and fire departments will be reviewed in Section IX (Service Delivery & Productivity).

Another recommendation for responding to increased demand includes creating a crisis standard of care. Crisis standards of care can help first responders determine if a call is serious enough for them to respond as they complete their triaging process (Jaffe et al., 2020A; Roman, J., 2020). Crisis standards of care could also be made publicly available (Jaffe et al, 2020A), thereby improving the community's information and reducing the chances of public panic. This can also help the community develop alternative solutions regarding who to call for service during a crisis (Pohl, 2017).

Pursuing these recommendations may reduce the demand for EMS and fire departments. In return, this could lead to improved patient care, reductions in patient deaths, and better community support. Reducing demand will also significantly impact EMS and fire departments' response capacities, which will be discussed in Section IX (Service Delivery and Productivity).

Needed Research

While the observations made in this section describe available research related to how EMS and fire demand has changed during the COVID-19 pandemic, there are still limitations to the collected literature. Primarily, there is little research available that allows us to easily disentangle fire demand (which is not a frequent subject of study) and emergency medical services (which is a frequent subject of research). Future research should also assess how mandatory lockdowns and stay-at-home orders impact the demand for fire organizations in coordination with how it affects related EMS organizations. There is little research evaluating if stay-at-home orders impact forest fires or house fires, which would change demand for services. Furthermore, there is a lack of research identifying how the combined increase in

COVID-related demand with the decrease in other areas of demand to affect the overall demand for service of first responder organizations.

III. Demand for Services - Crime

During a pandemic or natural disaster, first responder organizations will be asked to provide new services and conduct the tasks they typically performed previously. As an environmental effect, increases in demand may increase strain on organizations when they are concurrently facing the pandemic's direct effects on their personnel (e.g., infection, illness). Therefore, it is essential to explore the demand for various metrics relevant to first responders. Here we focus on crime.

Crime is one environmental effect that was subject to broad study in the collected literature. Crime is not only a demand for police services; it has a downstream impact on other first responder organizations as well. For example, crime is tied to demand for emergency medical services in the cases of violent crime resulting in injury. Levels of crime can also have downstream effects on law enforcement and the healthcare system both in the treatment of offenders and victims and follow-up investigations.

Natural disasters are a well-studied example of how the population's inability to pursue their normal routine activity patterns can often lead to adverse effects on society in the event of a crisis. Several scholars have studied changes in crime as a result of natural disasters, particularly hurricanes. Following Hurricane Katrina (2005), Hurricane Rita (2005), Hurricane Ivan (2004), and Hurricane Hugo (1989), significant short-term rises in burglaries were observed (Adams & Stewart, 2015; Casey, 2020; LeBeau, 2002; Leitner & Helbich, 2011; Walker et al., 2012). Researchers also found crime per capita increasing in counties that were directly hit by a storm (Spencer, 2017). Because the COVID-19 pandemic is rapidly developing and changes to people's lives and routines remain complex, it is difficult to predict the direction or magnitude of crime trends (Ashby, 2020B), even with insights from past events. Unlike natural disasters, the literature lacks a clear picture of the impact of the COVID-19 pandemic on crime; these disparate findings are described here.

Key and Consistent Findings

Across the United States, research indicates a decline in overall crime rates throughout the COVID-19 pandemic, with overall rates falling over 35 percent in Pittsburgh, New York City, San Francisco, Philadelphia, Washington DC, and Chicago (Abrams, 2020). Crime can include a variety of activities and not all types of crime have seen reductions or even any changes at all. Minor offenses such as vandalism and drug violations have seen significant decreases following lockdown measures (Abrams, 2020; Boman & Owen, 2020; Mohler et al., 2020; Rosenfeld & Lopez, 2020). For example, Philadelphia saw a 66 percent reduction in drug violations in a given week compared to the prior year (McDonald & Balkin, 2020). COVID-19 lockdowns and stay-at-home orders have altered peer group dynamics due to the closings of typical hangout spots such as schools and local businesses. Boman & Owen (2020) argue that these changes in social patterns is the driving force behind the reduction in minor offenses, as the context in which much criminal behavior occurs is removed. Some crimes are also a result of reduced proactive police activities, these activities were curtailed to limit the exposure of police officers (Lum et al., 2020B).

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Violent Crime in the United States. There is considerable variation in research regarding violent crime, and available studies regarding the changes in levels of violent crime in the United States lack consensus. While some studies find increases in overall trends and specific charges (Boman & Owen, 2020; Sutherland et al., 2020), others find decreases or no significant change (Abrams, 2020; McDonald & Balkin (2020). Each of these trends is discussed independently below.

Some research found increased crime related to the COVID-19 pandemic. Calls for service data reveal a sharp increase in shootings in 2020 compared to 2019 in New York City, Chicago, and Baltimore (Sutherland et al., 2020). Similarly, Hatchimonji et al. (2020) suggest that Philadelphia has seen its worst March for gun violence in five years, with 52 shooting victims during the first ten days of the city's stay-at-home order and homicides increasing by an estimated 15 percent between January 1- May 28 (Boman & Owen, 2020). An aggregated analysis using crime data from online portals of 27 U.S. city police departments studied weekly crime rates per 100,000 residents, shows a 37 percent increase in homicide, a 27 percent increase in robbery, and a 35 percent increase in assault in late May and June 2020 (Rosenfeld & Lopez, 2020). Likewise, Sutherland et al. (2020) found an increase in robbery in New York (22.4%) and Chicago (10%) compared to 2019, with other research finding similar results (Abrams, 2020; McDonald & Balkin, 2020). Domestic violence calls also increased by 7.5 percent from March through May 2020 in major metropolitan cities across the United States, with other studies finding similar results (Abrams, 2020; Boman & Owen, 2020; Leslie & Wilson, 2020; Mohler et al., 2020). For this reason, researchers have referred to intimate partner violence as a "hidden disaster" during the COVID-19 pandemic (Buttell & Ferreira, 2020).

On the other hand, other research contradicts these findings. For example, research using calls for service data identifies a 9.3 percent decrease in shootings in Los Angeles in 2020 compared with 2019 (Sutherland et al., 2020). Similarly, McDonald and Balkin (2020) identify a decline in shootings in Chicago and in homicides in New York, Los Angeles, San Francisco, and Chicago; however, the researchers only included data from March 15 to March 29, 2020, limiting their utility. Robbery and aggravated assault had similar declines across 26 of the largest cities in the United States, at 20.3 percent and 15.9 percent (Abrams, 2020). By contrast, simple assault fell over 33.3 percent (Abrams, 2020). This same research identifies a 17 percent decline in domestic violence reports and a substantial drop (38.3%) in reported rapes, with data being limited to Austin, Chicago, Nashville, and San Francisco (Abrams, 2020).

Some researchers also say the evidence relating to the impact of the pandemic on crime is inconclusive. Many researchers have argued that it is difficult to conclude any real changes in crime during the pandemic due to limited or mixed evidence, specifically when it comes to domestic violence (Ashby, 2020A; Piquero et al., 2020; Silverio-Murillo et al., 2020; Rosenfeld & Lopez, 2020). Ashby (2020A) suggests that the frequency shootings calls remained at expected levels in New Orleans, Seattle, and St. Petersburg, using data from January 1, 2016, to January 19, 2020. Likewise, research using criminal incidents, arrests, reports, and direct email requests show no significant decline in shootings and homicides across 25 large U.S. cities through the end of May 2020 (Abrams, 2020), with other researchers identifying similar trends (Ashby, 2020A; Boman & Owen, 2020; Rosenfeld & Lopez, 2020). The frequency of serious assaults and robberies appears not to have systematically changed during the

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early months of the coronavirus pandemic, with the observed variation within expected levels from previous years (Ashby, 2020B; Mohler et al., 2020).

Property Crime in the United States. Theoretically, social distancing should increase guardianship of residential properties and, in turn, reduce property crimes (Mohler et al., 2020). However, this may result in increased targeting of commercial locations with fewer people present due to lockdowns and social distancing requirements. When looking at the overall incidence of burglaries due to the COVID-19 pandemic, the research is mixed. Ashby (2020A) concludes that the frequency of burglary calls was significantly above expected levels in New Orleans, Seattle, and St. Petersburg, but remained within the expected range in seven other major U.S. cities. On the contrary, burglary calls for service were found to be lower in Los Angeles after shelter-in-place orders (Mohler et al., 2020). Separating residential burglaries from commercial yields different results. Rosenfeld and Lopez (2020) report that residential burglary dropped by 20 percent between February and June 2020 across 27 U.S. cities, while commercial burglaries rose significantly. With other researchers finding similar results, this suggests that criminal activity was displaced to locations with fewer people following stay-at-home orders (Abrams, 2020; Ashby, 2020B; Felson et al., 2020).

Violent Crime Outside the United States. Research outside the United States suggests that total crime is down. Researchers found a 9.4 percent reduction relative to the projected rate in Sweden (Gerell et al., 2020) and in the United Kingdom found a 41 percent reduction in the week following the initial lockdown (Halford et al., 2020). In contrast to the United States, there is a consensus among researchers that the frequency of violent crimes has fallen or stayed the same outside the United States (Balmori de la Miyar et al., 2020; Calderon-Anyosa & Kaufman, 2020; Gerell et al., 2020; Halford et al., 2020; Payne et al., 2020; Halford et al., 2020) except domestic violence (Zhang, 2020). After social distancing measures were put in place, murder rates dropped in Mexico to almost half of the national average, with similar results in Peru (Calderon-Anyosa & Kaufman, 2020). Assault rates also fell in Sweden, Mexico, Queensland (Australia), and the United Kingdom (Balmori de la Miyar et al., 2020; Gerell et al., 2020; Halford et al., 2020; Payne et al., 2020).

In China, family violence rates initially doubled in January 2020 and then tripled in February compared to the previous year (Zhang, 2020). The United Kingdom and Mexico have seen decreased domestic violence levels (Balmori de la Miyar et al., 2020; Halford et al., 2020). However, Queensland (Australia) has not observed any significant change (Payne et al., 2020).

Likewise, robbery was down by 57.6 percent and 40.6 percent in England and Wales during April and June 2020, respectively (Dixon et al., 2020; Dixon & Farrell, 2020). In contrast, Mexico and Sweden saw no real change in robberies (Balmori de la Miyar et al., 2020; Gerell et al., 2020).

Property Crime Outside the United States. Research consistently indicates reductions in property crime outside the United States. For example, the incidence of burglaries decreased in England, Wales, Mexico, Sweden, and the United Kingdom (Dixon & Farrell, 2020; Dixon et al., 2020; Halford et al., 2020; Gerell et al., 2020), with rates being 39.5 percent lower than expected in England and Wales in June 2020 (Dixon & Farrell, 2020). Furthermore, researchers also found the relative difference in residential

burglaries post-coronavirus compared to 2019 in Sweden to be -29.1 percent and -12.4 percent for commercial and residential burglaries respectively (Gerell et al., 2020) This reduction in residential burglaries is similar to the drop experienced in some major U.S. cities (Rosenfeld & Lopez, 2020).

Cybercrime. A handful of researchers have looked to determine the extent to which government lockdown measures have affected the incidence of cybercrime. With stay-at-home orders and decreased mobility, people's daily routines have been altered entirely - often forcing them to spend more time at home and online. One study in the United Kingdom reports that cybercrime increased by 43.24 percent during the COVID-19 pandemic, most notably during the two months with the strictest lockdown policies. Online fraud was observed to have increased by 50.95 percent, personal hacking by 77.41 percent, and social media hacking by 54.31 percent (Buil-Gil et al., 2020). According to Naidoo (2020), the primary victims include online banking consumers, social network site users, remote workers, online shopping users, and the unemployed. They also found social networking sites (39%), banks (24%), and technology firms (21%) were the top targets for impersonation (Naidoo, 2020).

Research Design & Limitations

A vast majority of the data used to evaluate crime rates throughout the COVID-19 pandemic is police calls for service in large cities. This may be because 9-1-1 calls are concrete events easily trackable over time and widely available to researchers (Ashby, 2020A). Call for service data is also a questionable measure of crime. Not all of these calls will be the result of crimes since callers can be mistaken in what they report, or crimes may not be reported at all, especially in the case of intimate partner violence (Ashby, 2020A; Boman & Owen, 2020).

Needed Research

Due to the limited period time articulated in the collected studies, additional research is needed that focuses on analyzing consistent data sources throughout the entire COVID-19 pandemics. In the case of domestic violence specifically, underreporting of incidents is a possible issue as more restrictions to people's mobility and higher levels of confinement may make it more difficult for victims to seek help or report incidents of abuse (Poblete-Cazenave, 2020). For this reason, further research is needed to study if and at what levels domestic violence is under-reported.

As the COVID-19 pandemic is ongoing, there is likely a time lag between published and current crime trends. The majority of research published uses data from the beginning of January to the end of April or, in rare cases, the middle of June. Some police commanders say COVID-19 and civil uprisings have forced them to redirect their resources (Jackman, 2020), whether due to budget cuts, strategic redeployment of forces to handle the unrest or job loss, and other stresses of the pandemic (Jackman, 2020). These factors likely will not be felt within the first months of the pandemic and social disorder. Their effects may only be magnified as the social and economic impacts of the pandemic continue. Therefore, the overall effect of social distancing and stay-at-home orders on crime thus far warrants additional analysis and discussion.

Because nearly all of the research concerning COVID-19 and crime focuses on large cities, we also cannot be sure that we are getting a full picture of crime in the United States. To determine if the trends in large

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cities are an accurate representation of the country as a whole, additional research is needed to better measure the impact of COVID-19 on crime in rural areas and smaller U.S. cities.

Apart from the COVID-19 pandemic, momentous social changes occurred in the United States in 2020. In particular, the mass protests sparked by the death of Gorge Floyd moved many individuals from their homes onto the streets. This social upheaval may be a contributor to crime during the COVID-19 and may explain why the United States has not experienced a similar reduction in crimes during the COVID-19 pandemic as other countries (Balmori de la Miyar et al., 2020; Calderon-Anyosa & Kaufman, 2020; Gerell et al., 2020; Halford et al., 2020; Payne et al., 2020; Halford et al., 2020). Economic strains due to lost jobs or insecure employment may also be a contributing factor to crime and social unrest. For this reason, further research is needed to differentiate the effects of COVID-19, economic uncertainty, and social unrest on crime rates across the United States.

IV. Occupational Exposure and Physical Health

First responders are at an increased risk of exposure to COVID-19 due to their jobs (Baker et al., 2020). Not only do they encounter more potential vectors of transmission than the typical worker, they also may be vulnerable to illness because of the occupational stressors, long hours, and other difficulties associated with their work.

Occupational exposure and physical health are tied to the direct effect of COVID-19 on first responders. Exposure to COVID-19 and pre-existing conditions that could exacerbate the seriousness of infection are likely to result in increased quarantines and absenteeism among first responders. Effective monitoring and reporting of illnesses (especially COVID-19 symptoms) are essential to reducing occupational exposure and workplace transmission.

Key & Consistent Findings

This section will describe consistent findings related to first responder rates of exposure and factors known to increase or decrease the likelihood of occupational exposure occurring on the job.

Heightened Risk. One analysis from Baker, Peckham, and Seixas (2020) clarifies the extent to which healthcare workers, police, corrections officers, and firefighters are at a heightened risk of occupational exposure to infectious disease compared to other American workers. These analyses leverage national employment statistics and big data techniques to estimate the risk levels COVID-19 poses to different employment groups. Baker et al., (2020) found that approximately 10 percent (14.4M) of U.S. workers are employed in occupations where exposure to infection or disease is likely to occur at least once per week (this includes chemical and physical exposures, bloodborne and airborne pathogens); if we examine the likelihood of exposure once per month, that number jumps to 18.4 percent (26.7M) of the total U.S. workforce (Baker et al., 2020).

Risk Factors and Preexisting Conditions. Certain medical conditions might make some individuals especially vulnerable to COVID-19. While each organization is different, leadership should regularly assess their employees' health status and institute programs designed to minimize risk factors that can

complicate infections of COVID-19, such as obesity, diabetes, and certain heart conditions. For instance, a recent study of federal police workers in Brazil found their sample of officers to have higher levels of obesity, and slightly lower O^2 (oxygen) saturation rates, compared to the general population (Dias et al., 2020). Indicators associated with hypertension and resting tachycardia were also present in this sample of federal officers, which suggests a need for further research and preventive measures to assess and ensure first responder personnel's health and well-being. Instituting preventive measures that can build resilience and buffer against potential infection's adverse effects will also be an important step in keeping first responders healthy during an outbreak.

Transmission and Exposure. Having identified certain occupations as carrying a greater risk of exposure and certain individuals as predisposed to COVID-19 complications, it is also helpful to frequently remind personnel in any job how exactly viral transmission can occur. Employee's underlying knowledge can permeate all aspects of their work. Valdez et al. (2005) provide one useful example of how infectious microbes spread during EMS routines. In their examination of emergency response vehicles before and after completion of a call for service, firefighters' hands constituted the primary vector of microbial spread (Valdez et al., 2005). They found that the use of hydrogen peroxide wipes significantly reduced viral loads on surfaces but that current cleaning practices (which do not utilize hydrogen peroxide) failed to do so (Valdez et al., 2015). More recent work has pointed to aerosol (airborne) transmission as the primary vector by which SARS-Cov-2 spreads between people (Anderson et al., 2020; Guo et al., 2020). Efforts into understanding the virus itself can have positive downstream impacts on personnel's behavior when it comes to proper decontamination measures, instituting these measures consistently, and ultimately reducing the spread of infectious microbes within the complex environments where first responders work.

Rates of Exposure. Exact rates of occupational exposure at the community level are constantly changing as new outbreaks occur in different locations, and as the pandemic undergoes multiple waves and evolutions. Early studies into the prevalence of exposure and/or quarantining among first responders presented alarming statistics. In New York City, an analysis found that 1,792 of 4,408 EMS responders (40.7%) and 3,873 of 11,230 firefighters (34.5%) were on medical leave for suspected or confirmed COVID-19 from March to June 2020 (Prezant et al., 2020). At other points in time, 19.3 percent of EMS and 13 percent of all firefighters were on leave (Prezant et al., 2020). Early in the COVID-19 pandemic, not all first responder groups were equally impacted: the Center for Evidence-Based Crime Policy and the International Association of Chiefs of Police report 60 percent of responding law enforcement agencies did not report increased COVID-related sick leave, while 34 percent reported small reductions in their number of available officers at the end of March 2020 (Lum et al., 2020B). Comparing these rates to mid-December 2020, for example, would result in a radically different picture with a greater overall magnitude and distribution of the virus as it spread throughout all 50 states and peak rates of infection continue to climb by the day. It is interesting to note that in Murphy et al.'s (2020) study of EMS workers, exposure rates appeared to improve (i.e., decrease) over time as providers became more accustomed to dealing with COVID-19 patients. In part, improvements may be driven by increases in PPE use compared to the early stages of the pandemic (Murphy et al., 2020).

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Key Predictors of Exposure. Rates of exposure are related to proper PPE use and strict compliance with precautions known to prevent and mitigate the spread of viral diseases like COVID-19(Murphy et al., 2020). Virus knowledge is also a key concern and can require extra training because the SARS-CoV-2 virus is so unique and because scientific knowledge of its spread has also undergone changes and revisions (e.g., the major shift from surface transmission to airborne transmission in summer 2020). In a retrospective study of occupational exposures in EMS settings in the United States, El Sayed et al. (2011) found exposure rates for viral respiratory illnesses to rise based on an analysis of exposure reports between 2007 and 2009. While this research was pre-COVID-19, respiratory droplets that spread through the air are particularly concerning when it comes to occupational exposure, compared to more apparent vectors of transmission like needle-stick injuries, which are rarer and appear to be on the decline (El Sayed et al., 2011). The authors highlight the importance of eye protection, in addition to N-95 masks and other PPE, in defending against these exposures in the future.

Knowledge of viral transmission among personnel is a key defense in limiting occupational exposure, and unfortunately, research has found that many first responders remain unclear about the symptoms and modes of transmission associated with different viruses (Shaban, Creedy, & Clark, 2003). Le et al. (2018) found gaps in knowledge and low rates of mastery among EMS workers when it comes to identifying symptomology and managing protocols for infectious diseases. On a positive note, research from Gershon et al. (2009) suggests that EMS knowledge of viral transmission and PPE can improve with the help of relatively simple and short training. Section XV (Training) outlines the benefits of training on PPE usage in more detail.

In a study of EMS providers in Virginia, researchers found inconsistent rates of compliance with universal precautions (CUP) and knowledge of universal precautions (KUP) among a sample of over 300 EMS personnel who manage incidents that carry a high risk of occupational exposure to HIV, hepatitis, and needle-borne infections (Harris & Nicolai, 2010). Research suggests that greater training and higher certification levels (e.g., advanced vs. basic EMT) were associated with better scores on CUP and KUP measures (Harris & Nicolai, 2010).

Interventions

With advancements designed to protect first responders on the job, strong leadership and proper PPE have been identified as critical factors in preventing exposure to the virus among first responders, and (in their absence) help explain why exposures do occur (Fu & Wang, 2020; Gershon et al., 2009; Murphy et al., 2020; Smith et al., 2020). Maintaining first responder personnel's accurate knowledge of transmission risks, symptomology, and conducting regular PPE training and keeping safety motivation high are essential to minimize occupational exposure.

Changes are being implemented by first responder organizations at all levels of activity in order to address occupational exposure. Some of these changes entail reconfiguring the current operations, for example, deploying firefighters in multiple vehicles instead of one (Stoof et al., 2020). Police are similarly altering their processes, even offering summons instead of arrest in some cases (Laufs & Waseem, 2020). And for EMTs, research has even addressed cadaver identification and proposed updated protocols to help keep first responder personnel safe under the changing circumstances (Fu & Wang, 2020).

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Leadership Style. A study of 743 career firefighters from across the United States found that a factor called "safety specific transformational leadership" is vital in minimizing first responders' occupational exposure (Smith et al., 2020). Safety specific transformational leadership (SSTL) involves organizational leaders who demonstrate a thoughtfulness about safety concerns and protocols as part of their leadership style. This will then motivate others to adopt healthy practices themselves (e.g., wearing PPE all the time, not just when it feels obvious). This research builds on previous work from Andriessen (1978), who found that workers' safety motivation is mostly determined by leadership and the safety standards of the leader, who sets the tone for the group. If a leader is lackadaisical about safety and PPE use, employees will follow; but if the leadership takes safety seriously, so will their personnel—as seen in this study of firefighters, who improved their PPE use and lowered their risk of occupational exposure under good leadership (Smith et al., 2020).

Monitoring Tools. Technological advancements in monitoring can help track responder safety, wellbeing/illness, and personal resilience throughout the pandemic. They can also facilitate early detection and appropriate steps for quarantine and isolating personnel. One such tool is the web-based Responder Safety, Tracking, and Resilience (R-STaR) system, developed by the Georgia Department of Public Health (DPH). This tool was piloted in connection with Hurricane Matthew in 2016 but is of potential use in other crisis situations as well (Turner et al., 2019). Tools like R-STaR can check in with first responders electronically and allow them to report issues, concerns, or symptoms of illness, all from a smartphone. Daily surveys are sent over email with R-STaR, and any reported injuries or exposures can then be forwarded to the appropriate agency for follow-up with the responder(s) who reported them.

Modeling Simulated Outbreaks. One research area of potential relevance to monitoring and mitigating the COVID pandemic is modeling a COVID-19 outbreak within a specific fire, police, or EMS organization. Thompson et al. (2020) simulated the impact of COVID-19 on a fire camp, studying how infection and fatality vary based on incident dynamics, duration, and assigned number of personnel. Fire camps are forward-deployed locations where firefighters live together when responding to wildlife fires. Their simulations indicate that screening personnel was more effective at mitigating the spread of COVID-19 during shorter incidents. However, if many personnel are providing services during a longer fire, social distancing measures are likely to more effectively mitigate an outbreak (Thompson et al., 2020). While Thompson et al. (2020) modeling is not real-world, they provide a useful picture of how COVID-19 can spread throughout an organization associated mitigation measures may protect organizations from the inside. This is especially of potential importance within fire and EMS organizations that may reside together inside fire stations for extended periods. Modeling studies such as these can help organizations prepare for crisis responses when trial and error is not possible or when best practices have yet to be established.

Improving Confined Indoor Spaces. New technologies can also help limit the likelihood of exposure to COVID-19 on the job, which most often results from extended time spent in indoor spaces (Bhagat et al., 2020; Velraj & Haghighat, 2020). Some of these advancements come from developing better PPE or PPE that is comfortable, ergonomic, and user-friendly, which encourages consistent use. Improvements to the work environment, like ventilation systems, can also minimize exposure risks by filtering indoor spaces. For example, Lindsley et al. (2019) evaluated the effectiveness of a new ambulance ventilation system

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designed to filter out infectious substances from the air. Using a simulator on board an ambulance, the researchers found only slight reductions in worker exposure due to the new ventilation system, which appeared to recirculate aerosol particles throughout the vehicle instead of eliminating them (Lindsley et al., 2019).

Needed Research

While virus knowledge and compliance with safety protocols represent two key predictors of occupational exposure, more research is needed to assess the extent to which these factors have evolved throughout the pandemic. Apart from a handful of studies that have examined antibody test results in specific groups (Caban-Martinez et al., 2020; Shukla et al., 2020), less is known about exposure rates among first responder groups. Among law enforcement and fire personnel, in particular, there is a deficit of research on a variety of PPE-related issues, including: PPE use over time, individuals' consistency in use and rates of proper use, factors that make individuals more or less likely to don PPE, and an understanding of how situational forces (e.g., responding to certain calls, the handling of specific cases) can influence first responders' willingness and ability to maintain full protection through social distancing and PPE safety measures like the use of facemasks. More work in this area will help nuance the discussion of how first responders can simultaneously perform their work while upholding social distancing requirements and PPE use in a way that does not compromise either of these two important duties.

V. PPE Use and Availability

PPE availability and use among first responders is a critical issue during the COVID-19 pandemic as it impacts other environmental factors such as exposure to disease, willingness to work, compliance issues with proper PPE use, and communication concerns. This section aims to examine scholarly research that informs our understanding of how personal protective equipment (PPE) is made available to and used by first responders.

Without adequate PPE or the proper knowledge to use this PPE, we will likely see increased occupational exposure of COVID-19. This exposure may lead to increased infections and subsequent direct effects on quarantines, absenteeism, and even mortality.

Key & Consistent Findings

This section will review the consistent findings regarding the availability, use, and effectiveness of PPE. The consistent findings improve our knowledge of how PPE policies impact the actions of first responders.

Availability of PPE. A common consensus throughout the collected literature is the availability of PPE has a substantial impact on first responders' willingness to come to work (Eastham et al., 1991; Foskett, 2020; Ventura et al., 2020). The second most common finding was that the risk of disease exposure significantly rises when PPE is unavailable (Tak et al., 2007). Foskett (2020) surveyed firefighters about their concerns regarding COVID-19 resources. While the number of surveyed firefighters is unknown, the

survey results found that 25 percent of firefighters reported a lack of PPE was the biggest concern during COVID-19. Foskett's analysis found that first responders were struggling to maintain PPE, which impacts the pace and willingness of firefighters to work. A study from Ventura et al. provides additional confirmation that reductions in PPE availability strongly impact response motivations. The study found that if PPE is unavailable, 12 percent of first responders and healthcare workers will not work if asked, and 7 percent would not work if required (Ventura et al., 2020, p. 5). The availability of PPE was also a major deciding factor in first responders' willingness to work and is discussed in Section XIV (Human Resources).

A second major finding of PPE availability issues is the risk of exposure to other diseases and health-related symptoms. Tak et al.'s study analyzed how the unavailability of PPE impacted exposure to other health hazards following Hurricane Katrina in 2005. Survey results from 525 firefighters found that 79 percent reported skin contact with floodwater, and 51 percent reported nose/mouth/eye contact with floodwater (Tak et al., 2007, p. 378-379). As a result of this exposure, 31 percent of firefighters reported new respiratory symptoms, and 49 percent experienced skin rashes (Tak et al., 2007, p. 379). Tak et al. (2007) concluded that exposure to other health hazards could have been avoided if firefighters were provided with proper PPE. Another study found that a lack of PPE among police departments and firefighters leads to increased reliance on COVID-19 antibody tests as exposure to COVID-19 was unknown (Shukla et al., 2020).

Use of PPE. First responder risk of exposure to COVID-19 may also be higher among personnel improperly utilizing PPE. The literature here concluded that everyday use issues include decontamination of PPE (Ventura et al., 2020), decreased use of PPE as the pandemic continues (Murphy et al., 2020), and inconsistent compliance with universal precautions (Harris et al., 2010).

Ventura et al. (2020) found that decontamination protocols are not standardized throughout the United States, and this could result in insufficient decontamination of PPE and medical equipment (p.4). They found EMS workers in highly populated cities fail to follow proper PPE disinfecting practices and hygiene standards, especially after encountering materials presenting biohazards (Ventura et al., 2020, p. 4). If EMS workers fail to decontaminate PPE and medical equipment properly, they risk exposing other EMS workers and patients to preventable infections. In a study of PPE use for simulated pediatric resuscitations, EMS personnel compliance with requirements was 61 percent for eye shields, 81 percent for respirators, and 87 percent for gowns and gloves (Watson et al., 2011, p. 515).

Murphy et al. (2020) also surveyed the continuing use of PPE among EMS workers. The survey examined EMS providers who cared for patients confirmed with COVID-19, then assessed if EMS exposure was mitigated by PPE use (p. 708). From 14 February 2020 to 26 March 2020, the study found that EMS use of PPE began at 67 percent, but PPE use fell to 34 percent, which suggests that as the pandemic is prolonged, the proper use of PPE by EMS personnel may decrease (Murphy et al., 2020). However, the study found that PPE use was associated with reductions in EMS exposure to COVID-19 for EMS workers who used PPE (Murphy et al., 2020).

Some research found inconsistent compliance along EMS workers regarding precautions standards to prevent exposures. A questionnaire by Harris et al. surveyed 311 EMS providers in Virginia assessing compliance with PPE use and decontamination efforts, such as wearing gloves, using face masks, proper disposal of needles, and proper monitoring of vital signs (Harris et al., 2010, p. 88). The results determined that 17 percent of EMS workers failed to wear gloves, 79 percent of EMS workers failed to dispose of contaminated materials properly, only 26 percent reported that they would use a mask when transporting a patient with an airborne disease other than tuberculosis (Harris et al., 2010, p. 89). While this research was pre-COVID, these inconsistencies with PPE use show potential exposures risk to other major diseases.

Effectiveness of PPE. PPE effectiveness involves the study of quality discrepancies in different mask types, if respiratory PPE is the most effective at preventing additional health hazards, and if PPE impacts speech and communication issues.

Offenddu et al. (2017) conducted a meta-analysis to assess the protective impact of N95 respirators versus the protective effect of other medical masks. The study found that wearing a medical mask or N95 respirator while working significantly protected EMS workers from contracting respiratory illnesses and influenza-like illnesses (Offenddu et al., 2017). However, the study additionally concluded that there is limited evidence that N95 masks have superiority over other medical masks (Offenddu et al., 2017). Following this study, it is crucial to assess if respiratory PPE is the most effective at preventing other respiratory problems. Data gathered from Melnikova et al. examined respiratory injuries among police, fire, and EMS. The data found that for all responders who did not wear PPE, respiratory problems were the top injury at 61.2 percent (Melnikova et al., 2018). For firefighters, respiratory problems were significantly higher in those who wore firefighter turnout gear (FFTOG) without respiratory PPE than those who wore FFTOG with respiratory PPE (Melnikova et al., 2018).

Finally, there is some concern that PPE may reduce productivity among EMS workers. Schumacher et al. (2013) and Parush et al. (2020) assessed if PPE reduces effective communication, transparency, and first responder productivity. An international survey found that EMS first responders in Israel and Portugal report that using full PPE resulted in hearing challenges, communication challenges, sight obstruction, and decreased situational awareness (Parush et al., 2020). Additionally, decreases in situational awareness reduced EMS worker ability to think clearly and make fast decisions under pressure (Parush et al., 2020). Changes in productivity due to PPE complications should be considered when developing new communication plans, productivity assessments, and response capabilities (Parush et al., 2020; Schumacher et al., 2013).

A unique research study by Schumacher et al. (2019) assessed if PPE impacted speech, hearing, and communication abilities among first responders. Evaluating this question of PPE is vital to determining if PPE use causes any unintended effects, such as unclear messaging. Schumacher et al. completed a test analyzing six different respirators and their impact on the clarity of speech and hearing. The study found that the Avon C50 respirator scored the highest on speech intelligibility (Schumacher et al., 2019, p. 2). While this study was highly controlled, it is an example of the need to assess how PPE impacts communication.

Research Design & Limitations

The studies in this topic area utilized a multitude of methods for determining the availability of PPE, the use of PPE, and the effectiveness of PPE. Many researchers used surveys or questionnaires to assess PPE availability and use among first responders. Some surveys occurred on a national level in the United States (Foskett, 2020), while other surveys focused on a specific EMS/fire/police department (Eastham et al., 1991; Harris et al., 2010; Murphy et al., 2020; Tak et al., 2007). Another common research method was meta-analyses, where data was gathered from pre-existing sources (Melnikova, et al., 2018; Offenddu et al., 2017; Ventura et al., 2020). Only Schumacher et al. conducted their randomized control trial to assess the effectiveness of PPE on an alternative impact, which in their case was communication impediments.

Interventions

Future policies recommended by the studies reviewed in this section tend to outline ways in which first responders can more effectively manage PPE so that equipment can be preserved. A study by Russi et al. (2020) outlined the importance of increasing telehealth activities to limit disease spread and exposure and conserve PPE for primarily first responders. Under this policy recommendation, the availability of PPE would increase as those who work in prehospital emergency care settings are prioritized in receiving PPE (Russi et al., 2020, p. 4). Additionally, Foskett's analysis proposes widespread use of the CDC PPE usage calculator tool. Through increased use of this tool, first responders can optimize their PPE use and calculate the average consumption rates for various types of PPE (Foskett 2020). The CDC PPE usage tool itself also likely required additional research. However, these recommendations may alleviate the strain on availability issues surrounding PPE.

Needed Research

Other policy recommendations can assess if PPE use and training methods can be universally applied to EMS, fire, and police departments. Melnikova et al. (2017) found that firefighters have the best use of PPE, but fire departments still have the least research and most reported injuries (p. 211). Increased research of PPE use in fire departments is recommended to assess how PPE reduces risk of injury or respiratory issues. There is an additional lack of research regarding PPE usage, compliance, and availability within police departments. Research in this area of study can also examine what types of PPE are the most effective at preventing injuries or other exposure risks. Assessing what training methods are common in fire departments and examining their applicability to EMS and police departments may also increase compliance with PPE usage. Watson et al. (2011) evaluated the use of a gatekeeper who controlled access and PPE donning, resulting in increased compliance.

There are also important questions to assess when reviewing the availability of PPE. Many of the researchers focused on the availability of N95 masks (Offeddu et al., 2017; Melnikova et al., 2017; Ventura et al., 2020), but the Offeddu et al. study demonstrated that N95 masks are not significantly superior to other medical masks. Therefore, additional research should assess why first responders are primarily concerned with the availability of N95 masks when other medical masks seem sufficient.

Supply chain management issues are an additional in need of research. There are two components to PPE usage: the first is PPE usage over time by a particular organization, and the second is obtaining PPE. Limited research has identified PPE usage, with Carrias et al. (2015) describing hypothetical use, but no research on actual usage during a pandemic was found among our collected literature. The availability of PPE is dependent on the supply chain. However, there is little research regarding how the flow of a supply chain impacts the movement of PPE from a manufacturer to first responders. Issues stemming from the supply chain may provide insight into how readily first responders can gain PPE access during shortages.

The study by Schumacher et al. poses an interesting question regarding how PPE impacts communication abilities. Throughout COVID-19, there has been widespread public pushback against the use of masks, with one of the complaints being hearing difficulties. Pursuing research examining if PPE prevents effective communication that results in a higher risk of disease or injury is essential during COVID-19. Assessing this concern can lead to improved communication policies in EMS workers and other first responders while still employing proper and effective PPE use. Future assessments should consider how increased exposure impacts staffing, demand, and changes in willingness to work.

Finally, in our collected literature, studies did not assess how the proper fit of gloves, masks, respirators, or other PPE impacted exposure to COVID-19 or other diseases and infections. Therefore, more research is needed on the significance of properly fitting PPE. Future research can include questions such as whether better fitting PPE makes first responders more likely to use it and how better fitting PPE reduces first responders' risk of exposure.

VI. Staffing

During the pandemic, COVID-19 can impact available staffing through exposures, quarantines due to exposure or suspected illness, infections, medical leave due to illness, and mortality. Staffing can include the direct effect of COVID-19 personnel on the quantity of available personnel. It can also refer to having available personnel more generally.

Suspected and confirmed exposure to COVID-19 and confirmed COVID-19 infections may require first responder personnel to quarantine. COVID-19 infection or exposure quarantines can last for up to 14 days due to the extreme transmission risks. Long-term absenteeism may also occur due to extended illness. First responders are also not immune to the mortality rates associated with COVID-19, especially considering their elevated risk of exposure, although some research reports mortality rates are lower for first responders than the whole population (Kokane et al., 2020).

Organizations also face turnover and retirements more generally. Personnel retire or take positions with other organizations, which reduces organizations' available staff. Turnover refers to the rate at which first responder personnel leave an agency and are replaced. In previous crises, such as Hurricane Katrina, rates of resignation, and retirement among first responders increased after the event (Wigginton, 2007). First responder agencies' capacity to maintain their quantity of available staff by increasing retention during times of crisis is an important discussion to consider. The collected literature did not yet provide

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sufficient material to consider the impacts of turnover or retirements on first responder agencies during COVID-19. This will be an issue of relevance in the long term.

Key & Consistent Findings

A primary finding of the collected literature is the impact of medical leave on first responders' staffing. Staff shortages can occur when first responders take medical leave due to illness or suspected illness (Gershon et al., 2010; Richards et al., 2006). Available literature indicates this is a significant issue during the current pandemic. Medical leave must be available to first responders during pandemics, such as COVID-19, so that infected personnel do not expose others in the organization and reduce the risk of community exposure, despite its impact on available staffing (Richards et al., 2006).

The quantity of available personnel, including EMS responders, firefighters, and law enforcement personnel, has been reduced in many locations due to medical leave during the COVID-19 pandemic (Jennings & Perez, 2020; Prezant et al., 2020). The staffing issues caused by COVID-19 is exemplified by available data from the New York City EMS system during the period when the pandemic was at its height. By March 21, 2020, 40.7 percent of EMS responders and 34.5 percent of firefighters in New York, New York, were on medical leave for suspected or confirmed COVID-19 cases (Prezant et al., 2020). The mean medical leave duration among these first responders was 25.3 days among confirmed cases and 19.8 days among suspected COVID-19 cases (Prezant et al., 2020). A study by Lum et al. (2020A) of police officers found differing effects on police organizations, with 60 percent of agencies not reporting noticeable officer sick leave due to COVID-19. However, eight percent of the agencies in this study did note five percent or more of their law enforcement personnel are taking medical leaves due to COVID-19 (Lum et al., 2020A).

Exposures to COVID-19 have significantly impacted first responder quarantines, medical leaves, and overall absenteeism. In King County, Washington, of an estimated 988 EMS provider encounters with COVID-19 patients, 327 resulted in possible EMS provider exposure (Murphy et al., 2020). 151 EMS provider encounters were determined to have been real exposures, resulting in 129 EMS personnel quarantining. During the peak of COVID-19, the number of EMS providers quarantining each day went as high as 69 (Murphy et al., 2020). One study of law enforcement agencies found that 28 percent of agencies experienced a one percent to five percent reduction in personnel due to COVID-10 infections or quarantines post-exposure (Lum et al., 2020B). In Maharashtra, India, an estimated 10 out of every 1,000 law enforcement personnel tested positive for COVID-19, creating significant amounts of absenteeism (Kokane et al., 2020).

Available staffing in one organization can also be impacted by a first responders' obligations to another first responder organization. Two-hat syndrome, or the employment of first responder personnel in multiple agencies, is a common phenomenon (Lindsell, 2012). Watkins et al. (2015) conducted a cross-sectional study of North Carolina's EMS system and found that 21 percent of EMS responders were committed to two systems, four percent to three, one percent to four, and less than one percent to five or more organizations at the same time. A study in Atlanta of fire and rescue personnel found 22.2 percent of responders worked for at least one other public safety agency (Lindsell, 2012). Diverse responsibilities can be difficult, especially during disaster events. As a result, first responders may be overcommitted,

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leading some agencies with unfilled positions during crisis events (Watkins et al., 2015). Two-hat syndrome is different than role abandonment, which occurs when first responder personnel abandons their posts during an event is more fully discussed in Section XII (Factors Impacting Deployment). It is also different than the concept of willingness to work, which for this review, refers to a first responders' willingness to report to work during disaster events and pandemic or epidemic events and is more fully discussed in Section XIV (Human Resources). In the collected literature, there was no research on the two-hat syndrome phenomenon during the COVID-19 pandemic.

Research Designs

Research designs utilized in the relevant studies included literature reviews (Jennings & Perez, 2020; Linsdell, 2012; Richards et al., 2006; Ungureanu & Bertolotti, 2020; Wigginton, 2007), surveys (Gershon et al., 2010; Kokane et al., 2020; Lum et al., 2020A; Lum et al., 2020B; Prezant et al., 2020), retrospective cohort studies (Murphy et al., 2020), and cross-sectional studies (Watkins et al., 2015). A significant portion of the literature addressed the impact of medical leave on first responder staffing (Gershon et al., 2010; Jennings & Perez, 2020; Prezant et al., 2020; Richards et al., 2006; Ungureanu & Bertolotti, 2020). A smaller potion addressed two-hat syndrome (Lindsell, 2012; Watkins et al., 2015). The collected literature was comprehensive in its efforts to consider all relevant first responder groups, including emergency medical personnel, fire rescue, and law enforcement.

Interventions

Interventions related to staffing can come in multiple forms. Some are relevant to preparedness and the development of appropriate plans to deal with reduced staffing. Others relate to hiring at the early stages of an event when it is predicted that additional staffing will be necessary.

A comprehensive all-hazard plan is described as a useful tool for ensuring sufficient staffing during a variety of different crisis events. Agencies would prepare to work with significantly reduced staffing caused by first responder personnel caring for family, getting infected themselves, or failing to report due to concern over infection risks (Richards et al., 2006). Staff reduction plans will reconsider the types of calls that usually require dispatching officers, identify responsibilities and functions that are a priority, and decide how lower priority tasks should be handled. These plans will include shifting personnel who perform non-essential functions into more critical roles (Jennings et al., 2020). This concept of staffing availability as part of preparedness plans, or surge capacity, is also described in more detail in Section I (Preparedness).

Medical leaves cause the staffing of first responder agencies to experience significant shortages. To address staff shortages caused by medical leaves during COVID-19, the Italian government legalized the hiring of an additional 20,000 public healthcare system workers. Within two weeks, 8,000 new workers comprised of recent graduates, retired professionals, army medical staff, non-profit organization medical staff, and paramedics were mobilized after being selected through a simplified procedure (Ungureanu & Bertolotti, 2020). Utilizing policy to develop emergency procedure exceptions that allow necessary staffing resources to be generated during crisis events may be an effective method to secure staffing.

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Needed Research

Needed research related to staffing comes in two forms. The first is concerned with staffing availability tied to exposures, quarantines over the short term, and illness during a particular event. The second is concerned with the long-term availability of personnel by organizations over time.

The exposure of first responders to COVID-19 and subsequent quarantines and absenteeism is understudied, as indicated in Section IV (Occupational Exposure). Research on this topic is vital to understanding the impact of exposure on the staffing of first responders during pandemics. The number of responders impacted by exposures, the length of time staffing resources was depleted, and the resulting quarantines, medical leaves, and fatalities of first responder personnel are all areas of relevant concern.

There is a lack of research on how COVID-19 has impacted the onboarding and retention of first responder personnel. In a survey of almost 1,000 law enforcement agencies, only 52 percent reported recruiting and hiring during the peak of COVID-19 (Lum et al., 2020B). The Police Executive Research Forum (PERF) also found that 36 percent of reporting agencies were planning to cancel or postpone hiring. While this survey should not be considered representative of all U.S. law enforcement, it does highlight the potential financial impacts that many organizations are experiencing (PERF, 2020A). Several discussions need to be considered that were not present in the literature. These discussions include the barriers, if any, to hiring new staff, training new staff, and rehiring previously employed first responders when the risk of infection is high. Two-hat syndrome and the resulting overcommitment of first responders is another area of needed research. The methods used to prioritize first responder duties and the impact such decision making has on agency staffing is of significant concern. This discussion relates to the findings of Section XII (Factors Impacting Deployment), which mentions duty-to-duty role conflict (Lindsell, 2012).

Long-term medical leaves have been a significant barrier to maintaining both new and previous staff. Medical leaves may impact an agency's turnover rates if responders choose to leave an agency rather than go back to work. The prevalence of such occurrences should be researched. The ability to generate and maintain sufficient staff and the barriers to doing so during events such as COVID-19 is worth further investigation.

In particular, more research is needed to identify how COVID-19 impacted the rates of resignation and retirement of first responders. Disaster events such as Hurricane Katrina resulted in many resignations and retirements by first responder personnel (Wigginton, 2007). One study found that approximately 12 percent of essential workers would consider early retirement if a severe pandemic occurred (Gershon et al., 2010). Resignation and retirement can have severe consequences for maintaining sufficient staffing at first responder agencies. The prevalence of these events during the COVID-19 pandemic needs to be evaluated and understood.

VII. Mental Health

Mental health among first responders is a keystone issue because it can influence several other aspects of the job (productivity, communication, human resources) and personal lives. Exposure to traumatic events and "critical incidents" impact first responders in both the short and long-term and repeated exposure to these situations over months or years, leading to burnout or conditions like "compassion fatigue." Mental health concerns range from posttraumatic stress disorder (PTSD) to burnout to depression and often include several comorbidities.

In addition to the clinical diagnoses of mental illnesses (common ones include PTSD and depression), there are other essential issues to consider within the realm of mental health, which first responder organizations should be aware of and work to address. Benedek et al. (2007) outline this range of emotional and behavioral responses; they include subclinical distress responses (things like fear, sleep disturbances, anxiety, and altered concentration), as well as behavior changes related to high-stress environments (smoking, alcohol use, evacuation/abandonment, and over dedication), in addition to formal mental health diagnoses.

Key & Consistent Findings

It is well-documented that responding to crises often leads to PTSD and depression. One review from Garbern, Ebbeling, and Bartels (2016) identified PTSD and depression as the two most studied mental health outcomes in their search of an Elsevier database (EMBASE) among first responders on the scene of natural disasters and humanitarian crises. Another sweeping review from Benedek et al. (2007) also identified acute stress disorder (ACD) and PTSD as some of the most critical issues facing first responders of several job types, including police, fire, EMS, volunteer emergency workers.

Unique Mental Health Challenges. Generally speaking, diagnoses related to PTSD and ASD are more common among first responders who respond to critical incidents (e.g., firefighters), while healthcare workers and EMS personnel are more susceptible to issues of burnout, anxiety, and social isolation (see, for example, Sahin et al., 2020). However, it can be difficult to establish reliable predictions about who will experience what type of mental health issue. In particular, when it comes to COVID-19, the current situation is so unique that it will likely deviate from past trends in how it affects first responder groups. That said, all first responder groups appear at an increased risk for depression and high levels of stress during the pandemic (Sindena et al., 2020; Stogner, Miller, McLean, 2020; Heber et al., 2020).

The estimated rate of PTSD among police is 7-19 percent (Drew & Martin, 2020; Faust & Vander Ven, 2014), and among firefighters, it appears to lie somewhere between 13-18 percent (Benedek et al., 2007). These estimates vary in part based on the type of event that one is exposed to. For example, rates of PTSD among police who were exposed to a single traumatic event were reported around 7 percent (Carlier et al., 1997). Among first responders who dealt with the 9/11 terrorist attacks, for example, the prevalence of PTSD was between 8 and 12 percent (Lowell et al., 2018); it was around 19 percent for officers who responded to Hurricane Katrina (West et al., 2008). With a long-wave event such as COVID-19, the prevalence of PTSD may depend on a responders' specific experiences.

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Increased Risk for Firefighters. Among firefighters, the focus of much work is on PTSD, given that the nature of their job involves routine encounters with physically threatening events, risk of injury, and death. In contrast, the generally accepted rate of PTSD among firefighters appears to be somewhere between 13-18 percent if measured within four years of a highly traumatic event (Benedek et al., 2007). A longitudinal study of firefighters in Australia found that most individuals who developed PTSD also experienced one or more comorbid conditions such as depression or phobic disorders (Benedek et al., 2007). Unfortunately, suicide represents an important concern in the fire community and one often associated with PTSD and depression (Heitman, 2016).

Establishing peer support groups, incorporating mental health concerns into formal training, and reporting rates of suicide, depression, and mental health issues to a centralized agency are a few of the recommendations for addressing these concerns in the literature (Heitman, 2016). Also, as fire and related organizations work to manage posttraumatic stress in their personnel, it is helpful to know the risk factors associated with moderate and severe PTSD. These include high levels of hostility and low levels of self-efficacy before the traumatic event, according to research from Heinrichs et al. (2005). Self-efficacy is the idea that one can control their situation and influence their life through their actions. It is closely tied to feelings of motivation (e.g., if you feel your actions can make a difference, you will be motivated to act) (Bandura, 2010).

Based on Bandura (2010), the first responder community should be aware that certain personality traits may result in some individuals being more vulnerable to PTSD and related symptoms of depression. Like self-efficacy and hostility, these personality traits were even more predictive of mental health outcomes than biological markers in Heinrichs et al.'s (2005) study of firefighters. Other research indicates that preexisting conditions related to stress and trauma are important predictors for exhibiting health problems after shared traumatic events (Morren et al., 2005).

Compassion Fatigue & Other Concerns. Apart from PTSD, ASD, and depression, another less common health outcome of concern is "compassion fatigue." Compassion fatigue constitutes a numbing response to the tragedy in place of grief, empathy, or similar emotions due to repeated exposure to tragic events. While many reviews like the one from Gabern and colleagues (2016) focus on disaster and humanitarian events (often short-wave and high-intensity incidents), a condition like compassion fatigue may be even more common and relevant to responders dealing with the COVID-19 pandemic.

The issue of compassion fatigue is related to anxiety and burnout, which also pose a threat to emergency workers during a pandemic. One study from Sahin et al. (2020) examined the prevalence of these conditions among healthcare workers, in particular, who have been dealing with the COVID-19 pandemic. Their study surveyed 920 personnel between April and May 2020 and found emergency service workers exhibited high levels of burnout (measured through the Maslach Burnout Inventory, MBI) compared to other healthcare workers (e.g., radiology, laboratory, or office workers).

Social Isolation. Social isolation can be a significant obstacle in the mental well-being of those who work on the front lines of health crises. For example, a study involving in-depth interviews with first responders during the Ebola outbreak in 2014 found feelings of loneliness and ostracization were

common along with a general fear from others or lack of trust (McMahon et al., 2016). The fact that healthcare workers and other first responders often must quarantine and forgo other coping behaviors (e.g., hugging, spending time with loved ones) out of precaution can exacerbate these feelings of loneliness.

Benedek et al. (2007) also describe social isolation instances among EMS personnel involved in a previous SARS outbreak. In two studies that investigated specific mental health outcomes of EMS and similar healthcare workers during the SARS epidemic (Bai et al., 2004; Maunder et al., 2003), both identified social isolation as an important adverse outcome among first responders. Bai et al. (2004) reported high levels of feeling of stigmatization among individuals in Taiwan who worked in emergency health settings during the SARS epidemic as a result of society reacting to them with fear or feelings that they may be contaminated or contagious.

Occupational Stressors due to COVID-19. Many agree that COVID-19 may represent "a potentially new type of critical incident," given the unique way it has affected all corners of society over one year (Drew & Martin, 2020, p. 34). This makes predictions of eventual mental outcomes difficult, but signs indicate that it may be a perfect storm of highly traumatizing, prolonged stress, and preventing adequate social support and connection that can often be used to combat mental health repercussions.

According to a review from Stogner and colleagues (2020), specific occupational stressors may weigh on first responders during the COVID-19 pandemic. Stogner et al. (2020) articulate these stressors in connection with law enforcement, but they apply to other first responder groups as well. These added stressors include: (1) implementing new policies such as stay-at-home orders and mask mandates, while the same policies are simultaneously debated in the political and economic spheres; (2) adapting to new realities and operational changes as a result of the virus (e.g., issuing summons instead of arrest; avoiding addressing minor offenses to limit contact with the public), and managing the cognitive dissonance that may accompany abstaining from typical procedures; (3) managing personal stress associated with a lack of PPE, such as facemasks and sanitizer, which has been a common problem in early stages on the pandemic; and (4) consistently risking their health and the health of their families by serving the public, and the stress associated with remaining hypervigilant and on-the-lookout for potential pathways of transmission, even when performing otherwise routine activities (Stogner et al., 2020). These occupational stressors can become a considerable burden. They may be compounded by a lack of social support, which is, unfortunately, more common in 2020 due to distancing requirements and limits on social gatherings.

Resilience. First responders deal with a range of stressful and traumatic events, both as part of responding to the COVID-19 pandemic and as part of their jobs as first responders. Available literature tells us that individuals vary in their ability to maintain healthy physical and mental functioning in the face of traumatic events or resilience (Laureys & Easton, 2019). Resilience as a concept is not well defined and includes the focus of resilience as a trait (specific personality characteristics adapt better) and a process (people adapt different ways over time across their lifespan) (Laureys & Eason, 2019). Resilience literature also indicates that there are demographic factors (e.g., gender, age, length of

service), personal characteristics (life satisfaction, self-esteem, empathy), ways of coping, and interpersonal components (Harrison et al., 2017; Laureys & Easton, 2019).

Research Designs & Limitations

In the literature review from Garbern, Ebbeling, and Bartels (2016) on the mental health of those who respond to disasters and similar events, the most common measurement instrument observed among their studies was the Impact of Event Scale (IES) (Garbern et al., 2016, p. 2). The IES scale assesses the severity of PTSD symptoms. Another common measure for this purpose is the Clinician Administered PTSD Scale (CAPS), which Gabern and colleagues describe as the "gold standard" for PTSD diagnoses. In measuring depression, the most common instrument in their search appears to be the Center for Epidemiologic Studies Depression Scale (CES-D).

Interventions

PTSD, depression, and the myriad of subclinical distress responses discussed here can all be pernicious on a personal level and detrimental to the workforce during a pandemic. Prevention and early detection of anxiety and burnout are two critical aspects of maintaining positive mental health among first responders (see Sahin et al., 2020, for example). Occupational stressors and fluctuating or demanding schedules can exacerbate these problems. Managers should allow for regularity in shift scheduling where possible and personal or vacation time to allow responders to spend time with family to support their mental health during the pandemic.

Every department and work unit may have its own culture around mental health, especially given the decentralized nature of many first responder organizations. A first responder organization can mitigate mental health effects by showing support for their personnel and making it known that matters of mental health and well-being will be accommodated and represent a reasonable response to the difficult situation at hand (Rooney & McNicholas, 2020).

Besides offering clinical help to those who need it, broad-spectrum wellness programs present another path forward, as they focus on building wellness instead of managing illness. Intervention options of this sort offer some evidence of effectiveness in past trials (Andersen et al., 2015; Chopko & Schwartz, 2009;). One such option is Mindfulness-Based Resilience Training, which research suggests can counteract the negative health effects described here and promote mental well-being (Christopher et al., 2016, 2018; Grupe et al., 2019; Laureys & Easton, 2019). Training such as this can help organizations who already have personnel with mental health concerns or units who want to be proactive about preventing mental health concerns among their team by building resilience.

Unconventional interventions in nontraditional settings have also been shown to help first responders and their families find a sense of normality in a complicated situation (Kronenberg et al., 2008). During Hurricane Katrina, cruise ships used to house the city's first responders were staffed with clinicians who met with these frontline workers as they went about their daily routine in an informal, conversational setting (Kronenberg et al., 2008).

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Unfortunately, the number of interventions thoroughly tested and validated for their effectiveness at treating or mitigating mental health concerns among first responders are few. Of the emerging work, one category is in mental health monitoring systems, such as the Critical Incident Stress Management (CISM) systems. Encouragingly, research suggests that offering immediate support following traumatic events can mitigate the negative impacts on first responders' mental health by helping them cope with stress and trauma (Flannery, 1999; as cited in Rooney & McNicholas, 2020). Even with some preliminary evidence, there simply are not enough options that have undergone rigorous testing and approval at this time (Rooney & McNicholas 2020). Also, many of the interventions or programs with the most evidence behind their utility are oriented toward helping with trauma and critical incidents (e.g., Carl et al., 2019; Castellano & Plionis, 2006; Jordan, 2007), and therefore less able to address drawn-out pandemics of the sort COVID-19 has been. Indeed, our literature search is consistent with this notion, as very few of the studies reviewed performed an intervention, to begin with, and even fewer carried out an evaluation of that intervention. Starting to evaluate programs that are in progress today will help us better understand what works to manage mental health during the unique situation this pandemic presents.

Needed Research

While most mental health research has focused on prevalent diagnoses like PTSD, there appears to be less work on subclinical mental health concerns (stress, fear, sleep disturbances, anxiety). Issues like social isolation, long work hours, and the potential for burnout are just as harmful to first responders as formal mental health diagnoses and significantly influence their ability to perform on the job. Overall, future work should consider the mental health repercussions outside of those related to newsworthy natural disasters.

Research on occupational stressors also warrants development. Stogner and colleagues (2020) provide a framework for thinking about occupational stressors among law enforcement, but further steps should be taken to help organizations combat occupational stressors, affecting not just police but any first responder working during the pandemic. The prolonged periods of risk and sacrifice associated with first responder workplace psychological strain on those individuals and can exacerbate pre-existing physical and mental conditions, lead to social isolation, and create tension in personal lives outside of work. Slocum's (2010) stress proliferation argument (which describes how stressors can compound, or snowball, in a cyclical motion) may be useful for understanding how COVID-related changes can interact with and exacerbate other stressors already present in first responder work.

Additional research to identify factors that make first responders more or less resilient during a long wave event like the COVID-19 pandemic would be helpful. Interestingly, Gabern et al. (2016) found mental health outcomes to be more commonly studied than physical health outcomes among civil, voluntary, or professional first responders "to a natural disaster or war-related emergency" (p. 2). However, their research suggests health outcomes still appear to be poorly monitored and deserving of more attention and infrastructure within first responder organizations.

VIII. Testing and Vaccines

Testing for SARS-CoV-2 and vaccination against the virus represent two critically important steps for disease prevention and control. They are also critical to protect personnel from exposure and infection, limit quarantines, absenteeism, and illness, and limit downstream indirect effects on first responder organizations.

Many studies in this domain focused on vaccination (rates and attitudes toward vaccination) and prophylaxis (i.e., actions taken to prevent disease). As one might expect, high rates of vaccination can have significant downstream effects on demand for first responder services. When administered within the first responder community, vaccination can both keep people safe and allow them to work through critical periods of heightened activity.

Key & Consistent Findings

Vaccination remains a tool of importance to both the general public and first responders—who are at increased risk of infection due to their jobs. However, observed rates of vaccination for common conditions like influenza and H1N1 remain below the levels desired by many health professionals. Some studies report 45-60 percent of personnel vaccinated (Beattie et al., 2013; Glaser et al., 2011; Hubble, Zontek, & Richards, 2010). This does not bode well for the current pandemic. Developing effective communication strategies, educational programs, and behaviorally informed programs will be crucial to gaining acceptance by first responders and improving vaccination rates as the COVID-19 vaccines become available.

Testing for SARS-CoV-2. Testing for SARS-Cov-2 has undergone several evolutions throughout the pandemic, and by this writing in late 2020, widespread testing has become much more available than it was in March and April. However, as we work to mitigate the current outbreak and plan for the next one, researchers and public health professionals have called for better preparedness and early action in the realm of testing. Tang, Bigelow, and Katz (2020) called for earlier and widespread screening for SARS-CoV-2 among first responders and highlight the unique importance of doing so in firehouses (where personnel live, dine, and sleep in close quarters) and in healthcare facilities where the risk of transmission is heightened.

Consider one study published in September 2020 that investigated the prevalence of COVID-19 among a large sample of first responders in Arizona. Of the 3,326 first responders included in this study, 50 (1.50%) tested positive for SARS-CoV-2 antibodies (Shukla et al., 2020). However, this snapshot view underrepresents the actual threat to personnel because it did not involve the ongoing testing needed to retain an accurate picture of the virus's prevalence. Therefore, one-time, cross-sectional designs are less informative than longitudinal studies that track the same participants over time (albeit these studies are more difficult to conduct). Interestingly, over half of the respondents in Shukla et al.'s (2020) study reported that antibody testing would help ease their anxieties related to work and improve their overall feelings of wellbeing in the workplace. As a result, perhaps organizations could consider sponsoring or otherwise providing free antibody testing to first responders at low cost.

Antibody Testing Among First Responders. One large-scale investigation from Akinbami et al. (2020) tested for the seroprevalence of SARS-CoV-2 (i.e., antibodies) among a broad group of first responders in the Detroit metropolitan area May-June 2020. They found a positivity rate of 6.9 percent in their sample of over 16,000 healthcare, first responder, and public safety workers. As expected, those who worked closer to the city center and worked in hospital emergency department settings were more likely to show seropositivity (i.e., test positive for antibodies). One of the best predictors of seropositivity was exposure to household members who had contracted the virus. Note that rates varied quite a bit among the 34 different sites in this study: from 0.5 percent to 17.9 percent. The consistent use of either N95 masks or surgical face masks was associated with a greater likelihood of testing negative (Akinbami et al., 2020).

A smaller study from Caban-Martinez et al. (2020) examined the prevalence of SARS-Cov-2 antibodies among a group of 203 firefighters and paramedics in South Florida. Collecting data over the two days of April 16 and 17, researchers first surveyed personnel about their attitudes, experiences, and medical history. The next day, they hosted a drive-through testing site, where an antibody test was performed. Of the 203 personnel tested, 18 (8.9%) had antibodies in their system. As expected, those firefighters/paramedics who tested positive experienced more frequent contact with COVID-19 patients compared to those who tested negative. Follow-up analyses indicated that none of the 18 individuals who tested positive had received an influenza vaccine in the past year (compared to 21% in the rest of the sample) (Caban-Martinez et al. 2020, p. 4). This finding led the authors to speculate that testing positive for antibodies could be associated with engagement in risky behavior or behaviors like the inconsistent use of PPE (Caban-Martinez et al. 2020). Their study did find slightly lower PPE use among those testing positive (who report using PPE 85.7% of the time) compared to those who tested negative (94.2% of the time) (p. 4), and these findings are consistent with those from Akinbami et al. (2020).

Attitudes Toward Vaccines. Understanding attitudes toward vaccines among the public and first responder communities provides important insights into how to provide optimal protection from disease while respecting individuals' views. For example, a study of 601 EMS professionals in North Carolina in 2008 found that around 48 percent of those surveyed had received an influenza vaccine over the previous year. Whether or not their employer offered free vaccines, vaccination training, or mandated vaccination were key predictors of who was vaccinated; however, only 9.1 percent of those surveyed supported mandatory vaccination policies (Hubble, Zontek, & Richards, 2010). This presents a difficult challenge for organizations who seek to simultaneously boost vaccination rates among their personnel for public health reasons while also respecting their autonomy and freedom of choice. Of the available options, offering free vaccines and vaccination education may be the most worthwhile avenues. A lack of belief in vaccine safety and effectiveness represents two factors that may have contributed to the low overall rates in this study (Hubble, Zontek, & Richards, 2010).

Another study from 2009-2010 of 199 police officers in the United Kingdom found that around 40 percent of those surveyed were willing to accept a swine flu vaccine. For those willing to take the vaccine, the most common motivations were out of concern for themselves being infected or to avoid infecting others; the key reason for those who indicated they would decline a vaccine was concern over potential side effects. Overall, younger employees, males, and those who took the threat of swine flu seriously were

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more likely to agree to accept the vaccine (Beattie et al., 2013). A study of H1N1 vaccination in Switzerland also found females slightly less likely to adopt vaccinations (Moser et al., 2016).

In the community of firefighters and EMS workers in New York responding to H1N1 concerns in 2009-2010, rates of vaccination in this population, targeting this disease, were slightly higher (55%) than those seen in North Carolina EMS workers (48% had influenza vaccine in 2008) or in UK police (40% vaccinated against swine flu, 2010). Still, all of these levels fall short of the vaccination rates medical professionals would like to see among first responders (Glaser et al., 2011). Researchers suggest that social norms may play an important role in encouraging vaccination, as vaccination acceptance appeared much higher in a group setting than private medical meetings/exams (Glaser et al., 2011).

Insights from studies like these can be used to refine information campaigns, and programs designed to (1) educate individuals and dispel misconceptions related to vaccines (e.g., that they create a high risk of complication and side effects), (2) create environments in which vaccination is more accessible (e.g., mobile sites, organizationally sponsored events), and (3) leverage social norms and the encouragement and confidence of others (e.g., group vaccination with organizational leaders present).

Research Design & Limitations

Much of the work on testing and vaccination utilizes survey methods to assess either first responders or the general public's attitudes. Some studies have examined attitudes in combination with testing and vaccination data, and this work can provide key insights into the factors that influence vaccination acceptance. With testing, some researchers have utilized public health data that provide testing rates in various locations or have evaluated programs that seek to deliver testing options to people in new or innovative ways. For example, the MEDICVAX Project utilized EMS to provide mobile testing/vaccination sites, as reported in Mosesso et al. (2009).

One study on the testing of infectious disease made use of a unique observational design to evaluate EMS and healthcare workers' ability to identify and manage patients exhibiting smallpox signs correctly. Klein, Atas, and Collins (2004) created a scenario in which patients called for EMS and imitated a smallpox infection according to its textbook symptomology. Researchers observed the receipt of (mock) patients in various urban and suburban locations. They checked the extent to which they correctly identified these patients as infectious and followed the associated protocols. Their study found that none of the ambulance personnel in their study correctly identified these patients. Of the 13 mock patients who were moved to and assessed in an emergency department, 54 percent were assessed by the staff as being potentially infected which resulted in initiation of a bio-agent protocol (Klein et al., 2004). Of these seven hospitals that did eventually identify these mock patients as "infected" and contagious, the researchers found that only two of those seven hospitals/emergency departments appeared to follow their proper notification protocols, which involved contacting local health departments (Klein et al., 2004). While the specific infection in this study (smallpox) is less common than COVID-19, observational designs like this can still provide important information relevant to early stages of a pandemic. More studies designed to evaluate current detection, prevention, and preparedness measures in the field will help provide a clearer picture of the first responder community's ability to respond to threats as they emerge.

Interventions

Researchers in Austria have begun to examine the utility of new training that would teach medical personnel techniques of mobile, pre-hospital diagnostics associated with COVID-19. Their training process includes the collection of bio swabs for RT-PCR testing, the proper use of PPE, and the appropriate steps in patient identification and communication (Mileder et al., 2020). Mobile testing sites such as these are important for both general containment of the virus and for effectively managing patients who may be contagious and therefore pose a risk to first responders, healthcare workers, and others if not adequately treated before entering the hospital setting.

Some organizations describe the use of emergency medical services to serve in a mobile testing role to limit the use of emergency department facilities. Goldberg et al. (2020) explored these home-based testing programs within the context of COVID-19. Citing the difficulties associated with traditional facility-based testing (travel costs, exposure and transmission concerns, logistical constraints of the facility), Goldberg and colleagues developed a system that leverages EMS resources to deliver SARS-CoV-2 testing to 15 homebound patients per day. By April 2020, their program had administered 477 home-based tests (and that number has almost certainly increased since then, especially since they had incorporated larger-scale drive-through testing sites). These sorts of testing options are significant for keeping high-risk populations out of hospitals and the emergency department. They can reduce costs and increase the reach of testing to those who may be homebound, frail, or unable to travel to a traditional facility (Goldberg et al., 2020). A similar approach was also adopted in Israel (Jaffe et al., 2020B), which combined this approach to expand their call-taking and dispatch system. As an alternative, Russi et al. (2020) indicate telehealth links between EMS providers and doctors could be used to provide input on-scene and limit transfers to the hospital.

In a similar line of thinking, Mosesso et al. (2009) reported on the MEDICVAX Project, which sought to utilize EMS workers and paramedics to administer influenza immunizations in the field to reduce costs and increase the reach of immunizations to populations that otherwise would not have received them. In their study of MEDICVAX across three countries and 15 EMS agencies, Mosesseo et al. (2009) found that the program successfully immunized 2,075 adults. Of this sample, 49 percent did not receive an influenza vaccine in the previous year, and 34 percent reported that they probably would not have been vaccinated elsewhere if not for the program's ease (Mosesseo et al., 2009). The costs associated with vaccinations, in this case, were low compared to traditional alternatives. While offering benefit to the public, such preventative measures may also benefit the EMS community in the long-run by resulting in lower demand for services during the high of influenza season due to having a more significant percentage of the population vaccinated (Brunetti et al., 2015; Mosesso et al., 2009).

Needed Research

While many studies examined attitudes toward vaccination, more research is needed to directly investigate communication strategies that can effectively convey the importance and safety of vaccinations related to the current pandemic. The mass media plays an important role in encouraging vaccination among the public, which can significantly affect the course of an outbreak and EMS workload (Brunetti et al., 2015). In an unfortunate example from Italy in 2014, the media's focus on a small number

of suspected complications associated with influenza vaccination discouraged the public from engaging in immunization. As Brunetti et al. (2015) state, "media hype that overemphasizes vaccine complications may result in lower vaccine coverage and may be followed by dramatically increased workloads for EMS during peak influenza season" (p. 62). The same lesson applies to the COVID-19 vaccination rollout.

There also appears to be a need for coronavirus-specific research and planning. Much research has focused on influenza pandemics or general infectious disease outbreaks, and generalizations are possible across these contexts; however, greater value can be extracted from an understanding of virus-specific testing plans, techniques, and attitudes vary based on the specific threat in question. For example, Qureshi and Scanlon (2007) evaluated the effectiveness of a plan from the Nassau County Department of Health (NC-DOH) that trained and operated several first-responder point-of-distribution clinics (FR-PODs) across the county's 71 local volunteer fire/EMS departments and police departments. Their evaluation found the plan and associated training to be both effective and well-liked, with trainees displaying an ability to process patients and manage issues as they arose. While encouraging, this training is often oriented toward infectious disease epidemics in general, and therefore are not specific to coronavirus outbreaks, which may have their own unique sets of concerns.

IX. Service Delivery and Productivity

First responder organizations provide a variety of services, and while some are in direct response to the COVID-19 pandemic, they also continue to deliver those they have always traditionally offered. Changes in the quantity and type of services first responders are asked to provide are more fully described in Section II (Demand for Services: Fire and EMS) and Section III (Demand for Services: Crime). This section outlines how organizations respond to the demand for their services during the COVID-19 pandemic.

Regretfully, systematic research on this topic appears to be limited. Two multi-organizational surveys regarding service delivery changes made by organizations were conducted (Lum et al., 2020A; Lum et al., 2020B; Stoof et al., 2020). There is also existing information that references service delivery changes made by organizations (PERF, 2020B) and studies that make recommendations on what organizations should do during the COVID-19 pandemic (Jennings & Perez, 2020; Moore et al., 2020; Richards et al., 2006). While some research is available about modifications to the emergency medical response by fire and EMS organizations (Ball et al., 2020; Jost et al., 2020; Katayama et al., 2020; Semeraro et al., 2020), it is not comprehensive.[8]

In exploring service delivery, it is necessary to differentiate between guidance, reporting, and research. Guidance involves recommendations on how organizations should be modifying service delivery. Guidance documents tend to be high-level, one-size-fits-all recommendations. Reporting relates to what changes organizations say they made in response to the pandemic. Research involves evaluations or assessments associated with the implementation of these service delivery changes. Not all guidance is

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[8] One area of research in service delivery was specific medical treatment approaches or interventions. These are not included here because they are outside of the project scope and the project team's subject matter expertise.

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reasonable or effective. Not all organizations adopt what may be recommended. Some guidance is partially implemented or adapted to fit an organization's needs, and not all implemented changes will be effective.

Key & Consistent Findings

Consistent findings are outlined independently below. First, we focus on the types of actions that organizations are recommended to take and report taking. Next, we focus on reported concerns by first responders related to service delivery to potentially infected individuals. Third, we outline the limited available literature documenting COVID-19-related service delivery measures.

Recommended Changes to Service Delivery. In this section, we will outline some guidance and what changes organizations report making. We include examples of guidance to highlight the need for research focusing on how these service delivery changes were implemented, assessed, and any downstream positive or negative impacts on personnel and the organization more generally.

Guidance comes from government and non-government sources and relates to the provision of services by all first responder groups. One example of guidance comes from the Vera Institute of Justice, whose focus is on police organizations. Their guidance relates to prevention, containing spread, and swift response (Vera, 2020). Prevention guidance includes recommendations to equip call takers and dispatchers to divert calls when police response is not required, issue citations in place of arrest, and increase patrol car cleaning frequency (Vera, 2020). Guidance involving containing spread includes using COVID screening tools for anyone brought into the police station and establishing policies for symptomatic officers or those who have been potentially exposed. Swift response includes establishing written response protocols and developing comprehensive sick leave policies to manage ongoing absences, quarantines, and staffing concerns (Vera, 2020). The New York State Bureau of Emergency Medical Services and Trauma Systems provides guidance related to assessment and screening, infection control, PPE, and precautions for aerosol-generating procedures related to COVID-19 (BMSTS, 2020). Guidance exists related to all first responder groups. It comes from a variety of state, local, and national government and non-government organizations.

Organizations report a variety of changes to how they deliver services. Lum et al. (2020B) describe various self-reported changes to agency operations and service delivery. They found that 95 percent of agencies report providing patrol officers with written criteria and guidance on responding to calls in person, and 85 percent provided guidance to detectives on modifying activities (Lum et al., 2020B, p. 1). Lum et al. (2020B) also report that 75 percent of reporting agencies mandated officers to reduce the use of physical arrests for minor offenses and 53 percent continued to place formal limits on proactive traffic or pedestrian stops (p. 2).

Of reporting agencies, 64 percent had also formally limited community-oriented policing activities (Lum et al., 2020, p. 2). Many organizations also report changes in how they interact with the community; 39 percent adopted formal policies to increase presence at places like grocery stores, public places, or other public spaces identified as needing attention. 63 percent of agencies also report providing their personnel formal criteria and guidance about enforcing social distancing (Lum et al., 2020, p. 2).

Please note, Lum et al.'s data (2020A; 2020B) sent surveys to approximately 5800 organizations each wave and had a 20 percent response rate. These are significant findings. However, as these are self-reported numbers and cross-sectional, they make it challenging to identify the organizational level impact of supply and demand for services and how organizations are functioning in the face of the pandemic. We also do not have information on the specifics of changes made, the context of the policies that are put in place, and the effectiveness.

Through the Police Executive Research Forum, various organizations indicate making changes in service delivery. Organizations from throughout the United States report limiting in-person responses and limiting enforcement of low-level offenses to reduce contact between officers and citizens (PERF, 2020B). They also report suspending in-person community engagement programs, reassigning officers' stations at schools and courthouses to other duties, and implementing new standard operating procedures (PERF, 2020B).

Stoof et al. (2020) report many fire organizations adopted social separation and hygiene measures at wildland firefighting camps. They also report that they have concerns in their ability to share help with other organizations through mutual aid agreements and requests and aid being available when they need it (Stoof et al., 2020). Many organizations also report COVD-19 will impact risk reduction activities (for fire prevention) and pre-season community engagement (Stoof et al., 2020). This means that many of the less essential tasks that fire units typically perform are being cut right now due to constraints related to the pandemic, which may cause greater demand in the future.

Lum et al. (2020B), Stoof et al. (2020), and the Police Executive Research Forum (2020) highlight the changes that organizations are making to service delivery in response to the pandemic based on available guidance or in response to community needs. However, less is known about the implementation and effectiveness of these approaches.

Experiences of Line-level Personnel. One area that has not been subject to significant study in our collected literature is the first responder experience of providing services (e.g., an EMT providing services to a COVID-infected patient) during pandemic situations. While negative impacts related to stress and mental health are outlined in Section VII (Mental Health) and willingness to work in Section XIV (Human Resources), the purpose of this section is to outline potential concerns of first responders who are providing services to infected and potentially infected patients.

Regretfully, none of the studies that we collected focused on understanding the first responder's experience directly providing care during the COVID-19 pandemic, an area of needed research that will be discussed later. Zolnikov and Furio (2020) conducted interviews with a mixed sample with a focus on social distancing perspectives in particular, a small number of which include first responders. In aggregate, Zolnikov and Furio (2020) report that respondents kept more than the normal distance in public places and even among family and friends. They also report a perceived lack of support and social isolation (Zolnikov & Furo, 2020). Their design is limited as it does not allow us to tease out the concerns of the limited number of fire, police, and EMS personnel in the sample from non-first responders in the study.

There is some information regarding the provision of care during the Ebola crisis from a healthcare and EMS perspective. More than anything, this research highlights the need for COVID-focused research that speaks to the experience of the providers themselves. Alexander et al. (2019) conducted focus groups with EMS medical personnel involved in providing care to Ebola-infected patients. Interestingly, these personnel report both a mix of fear of infection and excitement to be involved (Alexander et al., 2019). Participants indicate more training and increased transparency by their administration regarding how treatment protocols were developed led to more comfort in service delivery (Alexander et al., 2019). While training was provided related to patient transport, screening, and PPE, participants were also concerned about a lack of basic knowledge of disease transmission, which would help them put this training into action (Alexander et al., 2019). Interestingly, they were also potentially less concerned with Ebola and more concerned with other diseases like HIV, hepatitis, meningitis, and tuberculosis because they encountered them more frequently. Participants also report needs for continued education that included donning and doffing PPE combined with more training on infectious disease and adopting a peer training approach (Alexander et al., 2019).

Measuring Change in Service Delivery. In previous sections, we have identified recommendations or changes that first responder organizations report to how they deliver services. This section outlines the much more limited research related to the implementation and effectiveness of these service delivery changes. Much of the literature is focused on measuring changes in service delivery due to COVID-19 in emergency medical services in a variety of locations, including Italy (Perlini et al., 2020; Semeraro et al., 2020), Paris, France (Jost et al., 2020), Osaka, Japan (Katayama et al., 2020), and Victoria, Australia (Ball et al., 2020). Some of these changes in service delivery result from changes in demand for services and others relate to purposeful changes organizations implemented in how they deliver services to limit exposure. In the collected literature, no research studied service delivery changes among law enforcement.

Katayama et al. (2020) studied patient transport for acute diseases and traffic accidents from January 1 – April 14, 2020. Traffic accidents were investigated as a comparison group. While they found a decrease in demand for both acute disease and traffic accidents, they report increased difficulty gaining hospital acceptance for acute disease patients after the 13th week of the study (April 2020). There was not an identified increase in difficulty for traffic accidents. Katayama et al. (2020) report this increase may be due to these hospitals' ability to handle COVID-related symptoms. In comparison, a study of the effects of H1N1 influenza on the EMS system in Kobe, Japan, did not find a sizeable effect on the difficulty of gaining hospital acceptance (Tsubokura et al., 2009).

Ball et al. (2020) studied the impact of COVID-19 pandemic and COVID-related restrictions and treatment precautions on the incidence, characteristics, and survival of out-of-hospital cardiac arrest (OHCA) in Australia. OHCA requires a time-dependent emergency response, with survival being at around 10-12 percent (Ball et al., 2020). Ball et al. (2020) compared cases from the declaration of a state of emergency between March 16 and May 12, 2020, to cases between 2017 and 2019. The response to OHCA during COVID-19 is different due to the increased PPE requirements and dispatching of personnel, which may slow down response times and alter treatment decisions such as airway management and advanced life support (Ball et al., 2020). While overall emergency caseloads decreased, there was no change in adult

OHCA events between 2020 and the prior years (Ball et al., 2020). However, they did find a reduction (46.9% to 40.6%) in resuscitation attempts and a 2.5-minute reduction in resuscitation duration (Ball et al., 2020). Ball et al. (2020) also found delays in the provision of initial defibrillation and epinephrine (key life-saving techniques) and a significant decrease in the number of patients discharged alive (11.7% before and 6.1% during the period of emergency). These researchers report reductions could have occurred for various reasons, including PPE usage, EMS personnel encountering more patients dead-on-arrival, or less aggressiveness in attempts to resuscitate (Ball et al., 2020). Some of this reduced aggressiveness in resuscitation may be to fear of infection, but this is unknown (Ball et al., 2020).

Jost et al. (2020) also articulate changes related to OHCA treatment and requirements with the Paris Fire Brigade. They report that donning PPE took one minute but did not find differences in response times. They also report shifting basic life support (BLS) from one EMS personnel per patient to two per patient, but no report of differences in incidence, characteristics, and survival were found.

Productivity. Additionally, service delivery can be evaluated through changes in first responders' productivity. Standard operating procedures (SOPs) help assess first responder readiness for infectious diseases such as COVID-19 and determine if SOPs help maintain service delivery productivity (Andrew et al., 2018; Harwood, 2017). Surveys find that enacting SOPs has varying impacts on productivity and service delivery. Andrew (2017) et al. determined that SOPs improved first responders' planning capabilities, trust among coworkers, and faster responses to patients (2018). However, Harwood's study found that SOPs fail to recognize complexity in a situation, limiting the effectiveness of a first responder's ability to provide treatment to those demanding a service (2017).

In the COVID-19 era, changes and adaptations to SOPs are essential in improving service delivery and increasing productivity. Jost et al. (2020) emphasized that EMS and fire departments must develop SOPs that account for service delivery changes, such as the additional time needed to use PPE for both the first responders and patients (57). Incorporating these changes into service delivery planning will improve worker productivity in the COVID-19 era (Jost et al., 2020).

As we see from these studies, COVID-19 is affecting how organizations deliver services, particularly health-related services, which may in-turn impact both organizational programs and patients themselves.

Interventions

Organizations undertook several interventions to maintain their ability to deliver services due to increased or changing demand during COVID-19. These interventions were primarily EMS related. Two primary interventions were telephone triage and leveraging EMS for testing and treatment to divert patients from the hospital system. Leveraging EMS for testing is more fully explored in Section VIII (Testing and Vaccines). Regretfully, available research related to evaluations and interventions for police organizations related to service delivery was minimal.

Telephone Triage. Interventions often involve a concept identified by Khorram-Manesh (2020) as flexible surge capacity. While Khorram-Manesh (2020) describes flexible surge capacity as the use of human and material resources outside of the traditional medical system (such as veterinary and dental

professions), these interventions often involve the reorientation of available medical personnel and resources and reapplying these resources to account for changes in demand for services due to COVID-19. In many communities, due to the limiting of specific non-essential medical procedures and social distancing requirements, many medical service providers were idled and available to work, creating an increased and much-needed supply of personnel (Kristal et al., 2020). Surge capacity is recognized as a critical component of preparedness and is discussed in more detail in Section I (Preparedness).

One intervention implemented by various organizations in response to COVID-19 was establishing a system to handle the increased call volume. These interventions involved formalized triaging and diversion of calls and limiting unnecessary dispatching of EMS resources (Kristal et al., 2020; Marrazzo et al., 2020). Many organizations saw significant increases in call volume due to COVID-19 (Jaffe et al., 2020; Kristal et al., 2020), but not all people who call a 9-1-1 or similar hotline require immediate medical assistance. These interventions were designed to manage the high volume of calls effectively, distinguish low priority from high priority calls, and address calls related to confirmed or suspected cases of COVID-19.

A factor in this type of intervention, identified by Marrazzo et al. (2020), is known as "worried well," which refers to people calling on medical services seeking assurance and support but do not need medical care. In the time of COVID-19, this could involve people who were exposed but not symptomatic or who are experiencing other illness. These "worried well" calls can burden the healthcare system if they are not handled appropriately, especially if EMS personnel are dispatched to calls where treatment is not needed. These call center triage interventions sought to disentangle persons in need of immediate medical assistance from those in need of non-emergency medical intervention and from those who are "worried well."

Organizations implementing these approaches were located in New York City (Kristal et al., 2020), Milan, Italy (Marrazzo et al., 2020; Perlini et al., 2020), in the midwestern United States (Russi, et la., 2020), and in Israel (Jaffe et al., 2020). While a few of them involved telemedicine and health options (Russi et al., 2020), many of them were integrated with the standard EMS telephone systems to limit technological barriers to people calling for assistance and providers volunteering to support.

These triaging systems generally involve a layered approach that diverts callers based on their level of need. Perlini et al. (2020) identified constant updating of the triaging algorithms and coordination between units as vital to maintaining their ability to provide services. For example, in the latter stages of the outbreak, New York City implemented a two-tiered system staffed by nurses who handled information questions, isolation guidance, and mild COVID-19-like illness. If callers had shortness of breath or other more severe symptoms, they were passed to a more advanced provider (Kristal et al., 2020). As part of this system, healthcare providers could help the caller get emergency medical assistance if deemed necessary. In Israel, their system had 28,454 calls referred to their COVID-line, and 25.9 percent of these calls resulted in the dispatch of a paramedic (Jaffe et al., 2020, p. 480).

While dealing with a significant increase in call volume, the NYC approach could leverage volunteers providing care based on established guidelines (Kristal et al., 2020). Kristal et al. (2020) report several

complications to the system, including issues with the technology, difficulties in evaluating respiratory status over the phone, the need to connect people for virtual urgent care appointments, and follow-up with individuals experiencing symptoms. They implemented phone call and text messages to monitor symptoms and provided some patients pulse-oximeters to monitor blood oxygen levels for follow-up.

Unintended Consequences. One important consideration when implementing interventions that ask first responders to mobilize in new ways is the unintended consequences of these interventions. Stoof et al. (2020) found in their survey of wildlife professionals identified a problematic intervention that is often proposed to minimize exposure: reducing the number of personnel in vehicles and using more vehicles. Some respondents indicated that having fewer personnel in more vehicles may have negative consequences because driving exhausted (which may happen with more vehicles) is one of the most significant killers of wildland firefighters (Stoof et al., 2020). Having more vehicles on the road also increases the risk of routine accidents and raises costs associated with fuel and equipment. The changes highlight the ways in which changes to service delivery interact with myriad other aspects of the job for first responders, and therefore changes to service delivery should be well-measured and evaluated when possible.

Needed Research

Research needs related to service delivery are significant. There are three primary areas of needed research: the need to interview line-level personnel, the need to evaluate service delivery changes, and the need for more regular and in-depth evaluations of interventions. Each of these is outlined below.

Future research should involve conducting qualitative interviews with first responders who are directly providing care to infected and potentially infected individuals. Capturing and more systematically documenting these experiences will inform our understanding of organizational level service delivery and identify areas of concern of those providing care. This should include systematic interviews with line-level personnel directly providing care, such as firefighters responding to persons experiencing COVID symptoms in need of immediate life-saving care, EMS personnel transferring infected personnel in ambulances, or police officers responding to domestic incidents with potentially infected individuals.

Further assessment and evaluation of service delivery changes across first responder organizations is also needed. Organizations are making significant changes to how they deliver services during the COVID-19 pandemic. These changes are based on guidance from various sources, but little is known about the effectiveness of these service delivery approaches and other resulting impacts (positive or negative). For example, reducing the number of personnel in each unit could increase the response time to severe calls where multiple officers must respond. Research on the effectiveness of these changes is needed to distinguish effective from ineffective or counterproductive approaches.

Formal interventions implemented by organizations to deal with demand (such as call-taking processes and using EMS systems as mobile testing) should be subject to evaluation to the extent that organizations rely on them and determine the effectiveness of these approaches to providing care at the organizational level.

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In all, we need to systematically identify, assess, and evaluate service delivery changes made by organizations in response to the COVID-19 pandemic. First responder organizations themselves should also be encouraged to conduct these self-evaluations when possible since they are most familiar with the processes and outcomes associated with their changes. Giving first responder organizations the tools, resources, or support to conduct these evaluations themselves, and formalizing a centralized database of evaluated changes to service delivery, may help organizations share knowledge and clearly identify "what works." Through this process, it will be possible to identify evidence-based interventions organizations can use to protect their personnel and maintain service delivery in their community.

X. Public Health Mandates

The COVID-19 pandemic has spurred a flurry of federal, state, and local health mandates, all of which affect first responders and how they do their jobs, and some of which call on first responders to enforce these mandates. This section will overview how public health mandates such as stay-at-home orders/shelter-in-place orders, mandatory face coverings, physical distancing of six feet between persons, closures to schools and business, and accompanying public reactions affect first responders and the work they do. It involves a discussion of public reaction to these mandates, as these public reactions in turn influence the burden placed on first responders.

Key & Consistent Findings

When voluntary compliance is low, the police may be tasked with enforcing public health mandates. This is disadvantageous for both the police and the public, as "pandemic policing" can further exacerbate feelings of mistrust (Jones, 2020) and consume the resources of first responder organizations whose attention could be of better use elsewhere. Research has shown that trust in government is directly related to the extent to which individuals will comply with public health guidelines (Gilles et al., 2011; Prati, Pietrantoni, & Zani, 2011; Quinn et al., 2013); less trust is associated with lower levels of voluntary compliance. Therefore, strategies that may improve trust in government, engage the public in ways that build rapport and do not trigger an anti-authoritarian response, and communicate educationally about the virus are worth exploring as part of the effort to ease the outbreak's burden on first responders.

Police Enforcement of Public Health Mandates. The institution of stay-at-home orders/shelter-in-place orders in the United States in the spring of 2020 complicated local authorities' role. While these mandates can and have resulted in legal disputes, the details of which vary from case to case, scholars like White and Fradella (2020) have generally concluded that the enforcement of these orders "is the proper business of the police" (p. 11). These arguments are based on an understanding of police availability, their "impossibility mandate," their authority to use force, and their mission to protect human life, which is relevant to the COVID outbreak (White & Fradella, 2020). In step with this conclusion, one can observe countless examples of police sanctioning violators, including both individuals and businesses.

The list of individuals and businesses who have received sanctions, fines, or other law enforcement responses for failure to comply with COVID-related health mandates is significant. It includes the high-

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profile case of a pastor in Florida who oversaw church services with too many people in attendance (Johnson & Wolf, 2020). We have also seen traffic stops and border checkpoint programs that target drivers with out-of-state license plates to cut down on interstate travel (Lazo & Shaver, 2020). In some cases, they ask these drivers to quarantine if they remain a visitor in that state (Povich, 2020). With different mandates in different locations, responses from law enforcement also vary considerably. For example, in Maryland, violations of that state's stay-at-home orders can be considered a misdemeanor offense and result in fines of up to $5000, a year in jail, or both (Cummings, 2020).

While many agree police have the right to enforce these orders, others—including police leaders—have questioned the extent to which prioritizing the enforcement of these public health orders constitutes a wise use of resources during the pandemic (White & Fradella, 2020; Johnson & Wolf, 2020). This debate is further complicated because violations of these orders are not always a criminal offense. Legal scholars have reviewed several of these cases, often citing the Fourth Amendment of the United States Constitution (prohibiting "unreasonable search and seizures"), as well as the Commerce Clause (Cole, 2014); however, variability in state and local laws can make issues challenging to disentangle. As these debates and legal challenges play out, experts seem to agree that the optimal path toward compliance with health mandates would involve a high level of voluntary compliance instead of having to rely strictly on police enforcement (Pearl, Hunter, Lo & Chung, 2020).

Trust and Attitudes in Government. Attitudes toward government and issues of trust underlie the discussion of public health mandates and dramatically affect the public's willingness to comply and cooperate with authorities (Prati, Pietrantoni, & Zani, 2011; Quinn et al., 2013). Public reactions differ greatly across different cultures and countries (Torney-Purta, Barber, & Richardson, 2004). While some nations choose to enforce public health mandates through strict surveillance and social control, the United States is not one of these nations. Instead, the United States relies on individual decision-making and voluntary compliance. Gelfand et al. (2011) describe this as a "loose" culture. These compliance outcomes are largely dependent on the extent to which people trust institutions (Van Bavel et al., 2020). While the United States is a relatively transparent nation with a robust free press (Gordon, 2000), this transparency of government does not necessarily translate into trust in government (Mabillard & Pasquier, 2016).

While managing the public's reaction to public health mandates is not the primary job of first responders like police, fire, and EMS workers, it will impact their work in meaningful ways (Gilles et al., 2011). For example, greater cooperation with mask mandates will ease the burden on police tasked with enforcing these mandates. The associated reduction in viral spread will free up resources for EMTs who may be experiencing ballooning call volumes. The more compliant individuals are with directives to "stay home" or "shelter in place," the fewer calls for service there will be for unrelated incidents or accidents that can consume resources and put first responders in harm's way.

Investigations into past epidemics and disaster events can shed some light on how Americans are responding to public health mandates related to COVID-19. Group dynamics research suggests that when a nation faces external threats, that nation often responds by tightening its ingroup relations and strengthening its bonds (Greenaway & Cruwys, 2019). In line with this thinking, data from natural

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disaster events reveals that social trust and a willingness to work together increase in response to crisis events (Toya & Skidmore, 2014). However, because SARS-CoV-2 is less tangible than a natural disaster, and shrouded in controversy, political turmoil, and constant scientific debate, the "social trust" response that first responders would hope for may not be universal. Complicated dangers like the one this coronavirus presents may instead be met with suspicion and lead to conspiracy theories (Dussaillant & Guzmán, 2014; Wilson & Rose, 2014), which is characteristic of how some segments of the American public have responded. Indeed, solidifying quarantine legitimacy was essential to public compliance with health mandates during the SARS outbreak in Toronto in 2003 (DiGiovanni et al., 2004).

Interestingly, research from the H1N1 outbreaks suggests that trust in public health guidance appeared relatively high in the United States during that event (Paek et al., 2008; Quinn et al., 2013). However, a later study from Switzerland revealed that trust during H1N1 seemed to decline over time, as the pandemic wore on (Bangerter et al., 2012). These findings are complemented by work in the United States that found similar changes for the H1N1 outbreak: while perceptions of risk increased over time, individual's interest in being vaccinated and willingness to engage in health-related precautions decreased (Ibuka et al., 2010).

Interventions

The public's willingness to comply with precautionary measures may wear out over time. Therefore, new and more robust strategies may be required to promote compliance with health mandates in later stages of the pandemic compared to earlier stages. Interventions that are primarily communication related are described in Section XI.

Leadership and Communication Style. The way in which local leaders, including governors, mayors, police, and fire chiefs, present these public health mandates may also be important for how populations receive them. Research suggests that threatening language and punishment-oriented sanctions may convey the sense that the leadership does not trust individual people, which in turn may decrease the public's willingness to follow those orders (Mooijman et al., 2017). Instead, a better strategy for encouraging voluntary compliance with public health mandates would be for authorities to convey feelings respect in their speech and communicate confidence in people's ability to make smart decisions regarding expert advice on minimizing the spread of COVID-19 (Tyler, 2011).

Inter-agency Communication and Flexibility. Collaboration among local, state, and federal agencies is an important aspect of managing public reactions to health mandates (Matheny, 2013). Inter-agency collaboration may also help aid perceptions of legitimacy by forming a unified front of local and higher-level government entities, minimizing the risk of contrasting messages which is detrimental to public opinion (DiGiovanni et al, 2004).

Coordinated responses that involved multiple levels of government can lead to more comprehensive crisis management, however, they also create opportunities for miscommunication, redundancy/wasted resources, and unnecessary rigidity in the face of a changing situation that requires actors to adapt. This balance must be carefully managed to optimize a coordinated response. Research from Andrew et al. (2018) suggests that during the Ebola response in Texas, emergency managers pointed to

communication and collaboration between local leaders and state/federal authorities as an area of frustration and something to work toward improving during future responses to infectious disease outbreaks. The emergency workers interviewed as part of this study acknowledged the value of standard operating procedures (SOPs) but did so in conjunction with the flexibility of improvised decision making. This mix of prescribed standards and employee discretion is relevant to the COVID-19 outbreak because the health guidance related to controlling the virus has changed so much throughout the pandemic (e.g., shifting from a focus on surface transmission to airborne transmission). Due to the multiple levels of public health mandates and accompanying guidance, allowing discretion on the part of first responders will assuage some frustrations of failed communication plans and SOPs and also convey a sense of trust, which is an essential tool in promoting compliance (Gilles et al., 2011; Prati, Pietrantoni, & Zani, 2011).

Needed Research

While there has been a considerable amount of research on public opinion and attitudes toward public health mandates, less is known about how the day-to-day work of first responders is affected by public sentiment. While researchers continue to analyze and quantify these outcomes, making firm conclusions about the effectiveness and unintended consequences of physical distancing restrictions, updated cleaning procedures, and similar health measures would be premature at this time (see de Bruin et al., 2020, for a comprehensive review). Researchers can make inferences about how compliance with health guidelines can in turn reduce transmission and therefore demand for services, but firmer lines of connection would help clarify the relations among these variables and also the personal impact these processes have on first responders.

At the operational level, first responders' experiences are colored by the attitudes of those with whom they interact on calls for service and throughout the workday. Understanding more about the complex relationships between public health mandates, public reactions to them, and first responders' work would constitute an essential step toward helping first responders more efficiently conduct their work during a pandemic.

Also, first responders themselves may feel torn or conflicted about the public health mandates they are being asked to comply with or enforce. This problem is exacerbated by social distancing requirements may make the work of first responders more complicated (e.g., EMTs interacting with patients is less straightforward). Health mandates also strain first responders' mental health (Zolnikov & Furio, 2020). This creates disincentives for first responders themselves to comply with public health mandates, which are making their lives more difficult, even if the mandates are intended to reduce transmission and viral spread. Some research has looked at these issues in other contexts, but generally, this work is limited and includes a set of interviews with EMS workers related to influenza (Khan, 2019) and work on H1N1 (e.g., Rebmann et al., 2012). No research we are aware of has investigated police willingness to enforce public health mandates, for example, or interviewed law enforcement about the discretion they use when considering the extent to which they can enforce an order like mandatory face coverings in public spaces.

Since COVID-19 is more complicated and responses more controversial than past outbreaks like seasonal influenza, first responders' internal tension may be unique and perhaps more pronounced in the current case. More research is needed to weigh in on this speculation.

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While much research has shown that effective communication with the public *is* important, the identification of actionable communication strategies, or field-tests of extant public information campaigns, would yield more precise insights that health officials and first responders themselves could put into practice. A dearth of evaluation studies in this area represents a missed opportunity given the amount of public health information that has been released during the COVID-19 pandemic. The pieces of research that do exist in this area tend to identify what *not* to do (e.g., Page et al., 2013; DiGiovanni et al., 2004), and they also focus on the public health authority as the communicator instead of the first responder who interacts with the public directly daily. By understanding and building tools for first responder personnel at the ground level, we can better equip police, fire, and EMS workers with conversational tools that can help promote trust (and thus voluntary compliance), de-escalate situations, and combat misinformation in a way that builds rapport among the community, which will in turn make their jobs operate more effectively.

XI. Communications

Proper communication during an emergency is essential for communities and first responders as well-conceived and promptly delivered messages ensure public safety, ease response efforts, and maintain public confidence (Laufs & Waseem, 2020). A more informed and confident community may elicit cooperation, allowing first responder organizations to do their jobs effectively (Page et al., 2013).

Crisis communication is a broad topic in which information is abundant. Our review only begins to touch on the topic. A portion of this literature relates to communications during long wave events such as influenza or Ebola pandemics that focus on inter-agency collaboration and cooperation. This availability of research on these two events is likely because most high-profile communicable diseases affecting individuals at the global scale have a high impact on human life and economies. The large scale of these events makes crisis communication challenging to emergency management on its own, requiring an integrated approach (Andrew et al., 2018). In comparison, much of the literature on short wave events focuses on communication failures during natural disasters, where the events are sudden and unexpected.

Key and Consistent Findings

Communication during natural disasters and pandemics comes in three parts: Communication with the public, communication with personnel, and communication between agencies. In this section, we focus on communication with the public and inter-agency collaboration. Communication with personnel is explored in more detail in Section I (Preparedness), Section VII (Mental Health), and Section XV (Training), and research related to public health mandates are described in Section X (Public Health Mandates)

Communication with the Public. Community relationships with first responder organizations are often tested during pandemics and other emergencies. While there is research regarding first responder communication with the public during natural disasters and influenza pandemics, research regarding public communication during the COVID-19 pandemic is limited in our collected literature.

Sibley et al. (2020) compared matched samples of New Zealanders assessed before and during the first 18 days of lockdown, examining institutional trust and attitudes toward the nation and government. Their research found that people in the pandemic/lockdown group reported higher trust in politicians and police than people in the pre-lockdown pre-pandemic group (Sibley et al., 2020). Sibley et al. (2020) attribute this higher trust in government officials to their firm and cohesive national response and voluntary information-sharing process.

In comparison, while first responders' quick actions ensure public safety, miscommunication or misinformation can weaken the public's confidence and trust in the organization (Laufs & Waseem, 2020). Simon's (2009) analysis of the flow of information during the H1N1 influenza pandemic found it was better to have as much information as soon as possible—as long as the information was clear and reliable (Simon, 2009). With emerging technology being so advanced and widespread, information can be quickly spread and connect community members, benefiting individual stakeholders during a complex situation (Page et al., 2013).

Emerging diseases with uncertain trajectories tend to attract disproportionate news coverage, which is troubling as the public at large is less concerned with scientific data and is easily influenced by media sensationalizing risks (Andrew et al., 2018). Research suggests that the public's concern is focused primarily on who makes decisions that affect others' safety or well-being and whether they can be trusted (Andrew et al., 2018). Furthermore, in a disaster situation, if there is an inability to communicate among a first responder organization, it contributes greatly to the spread of misinformation. It allows the media to take control of the public viewpoint. For example, during Hurricane Katrina, the press sensationalized accounts of violent crime and atrocities committed against citizens who evacuated to the Louisiana Superdome (Wigginton, 2007). However, the New Orleans police department could not confirm or deny these reports because their communications network was not functioning (Varano & Schafer, 2012; Wigginton, 2007).

To maintain public trust in first responders during emergency situations, research suggests that official social media accounts establish "two-way, trust-based" communication with the public to ensure a coordinated response to the emergency (Laufs & Waseem, 2020). Police Chief Ed Roessler of Fairfax County, Virginia, suggests that their new emphasis on the sanctity of life, the co-production of policing with employee groups and community members, and the transparency in leadership are the most profound changes in the policing profession (Police Executive Research Forum, 2020). Continuing to institute these transparency measures and properly disseminating accurate information is important to minimize fear and anxiety among the public and gain their trust (Page et al., 2013).

Numerous organizations have utilized social media to increase transparency and communication to the public, which can help lessen the public fear, decrease the public uncertainty, and enhance credibility of responders (Page et al., 2013). Several studies reported how fire and police departments' use of social media increased during disasters, emphasizing how new accounts were created by agencies (Laufs & Waseem, 2020). For example, in Queensland (Australia) during flooding incidents, the Police Service used social media to provide situational information, advice and to tackle misinformation (Bruns et al., 2012). During Hurricane Harvey, Houston's first responder groups gave 13,000 tweets using Twitter's streaming

API, across three phases of the Hurricane Harvey event: preparedness, response, and recovery, with the personal accounts of the city's police and fire chiefs being the most influential (Yang & Stewart, 2019). By publicly communicating preparedness, response, and recovery efforts, first responder organizations can maintain and improve their relationship with the community and in turn, make them safer and less likely to be influenced by biased media frames (Andrew et al., 2018).

Communicating with the Public. In addition to grassroots education related to health and transmission (to be discussed in a later section), effective public information campaigns can help health authorities communicate with the public in a manner that improves the likelihood of compliance with health guidelines. Investigations into the 2003 SARS outbreak in Toronto revealed that inconsistencies in messaging (e.g., reporting different rates of infection, broadcasting contrasting sets of quarantine guidelines, describing quarantine as "voluntary" and later as "mandatory"), or uncertainties about the virus and its course, created "confusion and some consternation" among the public and therefore should be avoided when possible in the future (DiGiovanni et al., 2004, p. 269). Interviews and focus groups from DiGiovanni et al. (2004) reveal that having a single, trustworthy spokesperson appeared to be a better strategy than having multiple and that 63 percent of poll respondents would prefer this spokesperson to be a physician of health official (p. 269-270).

Other investigations into effective messaging yield similar insights: a study of Hurricane Irene (2011, natural disaster) and the theater shooting in Aurora, Colorado (2012, mass shooting) also found consistency in messaging to be an essential factor in how it is received (Page et al., 2013). The authors of this comparative study offer three best practice suggestions for communication during a crisis: (1) integrating messaging across social media channels and including photos, videos, and graphics as part of this messaging to help observers stay richly informed, and (2) addressing rumors, fake photos, and misinformation promptly—policing the web for such incidents, and (3) thinking carefully about the appropriateness of attributing specific messages to specific sources (Page et al., 2013, p. 29-30).

Inter-Agency Collaboration and Cooperation. Emergency events are often complex, dynamic, and high-stakes environments that require collaboration within an agency and coordinated operations on an inter-agency level. Often, the challenges public health emergencies and other disasters pose are too complicated for a single agency to manage (Dijk et al., 2019; Laufs & Waseem, 2020). Research suggests collaboration between emergency management organizations is crucial to minimize the duplication of efforts (Andrew et al., 2018), eliminate the waste of resources (Lis & Resnick, 2018) and to address the challenges of coordination and system barriers that occur in the initial stages of immediately following an event (Mann & Williams, 2020). For example, in Miami Florida, the police department receives daily information from the Department of Health on locations where people have tested positive for COVID, so officers use extra precautions with their PPE gear when dispatched to that location (PERF, 2020A). This partnership and others like it ensure the safety and appropriate care for first responders, patients, and the public.

While inter-agency collaboration and cooperation have clear benefits, research indicates a lack of communication among organizations across political boundaries at the state and federal level (Andrew et al., 2018). Furthermore, significant weaknesses in the public safety agency environment have resulted

from the lack of interoperability between different first responder communication systems and the unwillingness of public safety agencies and non-profit organizations to share information or resources and communicate across jurisdictional lines (Baker, 2013; Varano & Schafer, 2012). For example, following a tornado in 2011, the Joplin-Duquesne Fire Department members recalled being turned down by the Red Cross for cots because the place of shelter chosen was not being sponsored by the Red Cross explicitly (Mason et al., 2017).

In addition to this common resistance to share resources and knowledge, a clear boundary to inter-agency collaboration is physical restrictions. Different public safety agencies, such as police officers, firefighters, and other service industries, cannot work well together because their communication equipment is not always interoperable (Baker, 2013). Hence direct communication is not always an option in inter-agency collaboration, potentially limiting the partnership to higher levels of jurisdiction rather than personnel in the field. Furthermore, a study regarding fusion centers and Joint Terrorism Task Forces found that the two agencies want to collaborate with the public health sector but face integration obstacles such as funding, workforce, and resources (Minks, 2018).

Needed Research

While this literature review reflects on how first responder organizations communicate during an emergency, there are relevant limitations to the available research that call for further investigation. Interoperability gaps were primarily prevalent among first responder organizations before the COVID-19 pandemic (Baker, 2013). Researchers should determine if this continued to be an issue more recently. While research is unlikely to evaluate specific communication devices, it would be easier to identify interoperability gaps and potentially source private market solutions to the public safety communications infrastructure. Finally, as earlier discussed, inter-agency collaboration was hampered by political boundaries and the unwillingness of public safety agencies to share information across jurisdictional lines (Andrew et al., 2018; Baker, 2013). It would be good to determine if this continued into the present. Further research should also assess methods to make public safety agencies aware of the benefits of collaboration and the drawbacks of working on a situation alone. It is ideal for agencies to promote a culture of information sharing.

XII. Factors Impacting Deployment

Law enforcement, emergency medical services, and fire rescue agencies are all essential in protecting and guiding the public. Their resources, both material and human, must be deployed effectively and efficiently. In this section, we cover several topics of relevance ensuring that organizations have adequate numbers of personnel for deployment during a disaster.

How an organization deploys personnel may be due to changes in demand for services (environmental effects), due to decreased available staff (direct effects), or other factors. Aspects of deployment are also described in Section IX (Service Delivery and Productivity).

Key & Consistent Findings

Two crucial areas of relevance to the deployment of personnel are role conflict and task changes. Each are described independently below.

Role Conflict. A primary finding of the collected literature is the impact role conflict has on first responders' deployment. Role conflict is consistently identified as a barrier to deploying first responders during disaster situations (Linsdell, 2012; Raj et al., 2011) and pandemics (Barnett et al., 2010; Qureshi et al., 2013). First responders are more likely to abandon their posts when, in a given event, there is significant conflict between family and duty, and risk of disease transmission to family exists (Linsdell, 2012; Raj et al., 2011). The formal term used in the literature is "role abandonment."

During disaster situations where significant police presence is required, it is reported that officers experience family-to-work conflict due to the inability to help family members (Raj et al., 2011). During Hurricane Katrina, over two-hundred-and-forty officers did not go to work. After the disaster, sixty officers resigned. Over the coming year, the New Orleans Police Department (NOPD) would lose an average of 17 officers a month to other law enforcement agencies and resignations (Adams & Stewart, 2015; Linsdell, 2012; Wigginton, 2007). These events reveal that catastrophic events can cause first responders to treat duty as a secondary role.

The infrastructure of first responder agencies before disaster situations was also found to be relevant to role abandonment. Agencies with a lack of adequate technical tools for communication, transportation, shelter, and weak command structures are most likely to increase first responders' distress (Deflem & Sutphin, 2009; Matarazzo et al., 2020). The New Orleans Police Department is such an agency, with a reputation for corruption, lower education levels among the workforce, and poor management (Deflem & Sutphin, 2009; Wigginton, 2007). Offices did not have the necessary comfort of showers, beds, or personal space post-Hurricane Katrina and their command structure failed to provide effective leadership (Deflem & Sutphin, 2009). These are situations during which officers may relinquish their duty altogether due to a lack of structure (Deflem & Sutphin, 2009).

Less is reported on role abandonment among EMS and fire personnel. Available literature relates to the concept of willingness to work during a future event, not abandoning their posts in the current pandemic. Willingness to work is more fully described in Section XIV (Human Resources). In a study conducted by Barnett et al. (2013), the willingness-to-report rate among EMS responders was 48 percent when disease transmission to family members was possible. Their research also found that 52 percent of EMS responders would stay home if the risk of transmission to family existed (Barnett et al., 2013). Duty-to-duty conflict (or Two-Hat Syndrome) was also found to deployment of first responders, as many are part of more than one emergency response agency (Lindsell, 2012).

Altered Tasks. The COVID-19 pandemic has significantly altered the tasks for which first responders are deployed. Mainly, police forces in the United States are being utilized outside their typical scope of practice. Detectives, deputies, and other personnel have been reassigned to patrol high visibility locations such as recreational areas, work in crowded public spaces to help maintain order, and find social

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gatherings that need direction to disperse (Jennings & Perez, 2020; Lum et al., 2020). The alteration of police tasks is an international phenomenon in response to COVID-19.

One example is in the Republic of Ireland, which has implemented legislation altering the tasks of the Garda Siochána. The Garda Siochána has been given the jurisdiction to direct citizens to comply with COVID-19 legislation, request identification information of citizens suspected of breaking lockdown guidelines, and perform additional forms of arrest (Rooney & McNicholas, 2020). Altered tasks during pandemics may have significant implications for all first responders and are also described in Section X (Public Health Mandates).

Research Designs & Limitations

Research designs utilized in the relevant studies included focus groups derived from state-level surveys (Qureshi et al., 2013; Raj et al., 2011), case studies (Wigginton, 2005), national surveys (Barnett et al., 2010), and literature reviews (Deflem & Sutphin, 2009; Jennings & Perez, 2020; Lindsell, 2012; Rooney & McNicholas, 2020). The first responder population of interest in most studies, in particular the literature reviews, was law enforcement. Emergency medical personnel were the primary population of interest in research where quantitative data was collected. Research addressing role abandonment was primarily developed through tools such as focus groups (Qureshi et al., 2013) and surveys (Barnett et al., 2010; Raj et al., 2011).

Interventions

One of the primary concerns of first responders during disaster situations and pandemics is the well-being and safety of their family members. A focus group conducted in Hawaii by Qureshi et al. (2013) suggested that increased flexibility to leave work to address problems at home, allowing extended shifts where essential workers can stay at work so as not to expose their family members, and prioritization of vaccination of essential workers and their families would reduce role conflict. Role conflict can be reduced by facilitating improved communication between first responders and their families, on an ongoing basis, during these events (Lindsell, 2012; Qureshi et al., 2013). An increase of mechanisms to care for children and elderly members of a family in the absence of a responder is also perceived as a condition that would reduce role abandonment (Lindsell, 2012).

In aggregate, this research shows a lack of proper support and resources available to first responder families. Program and policy implementation at local, state, and national levels that produce adequate support and resources are necessary. These programs and policies can reduce role conflict. Proper support and resources include, but are not limited to, designated shelter locations, transportation services, open channels for communication, and sufficient family healthcare coverage options (Goodman and Mann, 2008; Gershon et al., 2010; Rebmann et al., 2014). These interventions would increase the stability of deployment during disaster situations and pandemics. The collected literature also suggests that training related to equipment and proper procedure would reduce role conflict and better prepare first responders for altering tasks. This topic is discussed in Section XV (Training).

Needed Research

The conclusions reached during this literature review were narrow in focus. Most commonly, deployment was included in discussions about first responder willingness to work and law enforcement adaptations to COVID-19. More research is needed to determine if role abandonment occurred across all first responder groups or, in the case of a long-term event like COVID-19, to what degree personnel could not make it to work due to role conflict.

Another area of needed research is how typical first responder tasks may have been altered or the extent they are asked to provide new tasks they did not formally provide. The present literature briefly discusses law enforcement's experience with altered tasks during COVID-19. There is a need for a more comprehensive discussion of this topic that also addresses emergency medical personnel and fire rescue experiences.

There is a lack of research analyzing changes to deployment procedures during significant disaster situations and pandemics. A discussion by Adams and Stewart (2015) briefly identifies self-organization as a phenomenon during disaster events. Self-organization occurs when a command structure is hindered due to a failing communication system. Mid and lower-level workers must rely on their own assessments of a crisis to operate (Adams & Stewart, 2015). This phenomenon is most certainly a tendency that influences first responders' deployment and is worth further review. There is also a lack of research assessing the immediate and long-term impact of deployment procedure changes during disaster situations and pandemics. For example, have altered tasks during the deployment of law enforcement impacted the overall ability to provides services? Understanding the immediate and long-term results of such events may benefit the development of deployment procedures for future events.

XIII. Transportation

Transportation is a critical aspect of all first responders' jobs, and it relates to several other topics discussed here (e.g., occupational exposure, deployment). The transportation of patients and civilians during the COVID-19 pandemic places first responders at significant risk for contracting the virus. For example, invasive resuscitation techniques associated with cardiac arrests call place providers at increased risk of exposure to pathogens (O'Connell et al., 2020). Altering transportation procedures, supplying sufficient personal protective equipment, and training first responders on best transportation practices is essential to minimizing exposure.

Two important concepts associated with transport are primary and secondary transports and closed and open transports. Primary transports are the transportation of patients from their homes to an appropriate medical facility to receive care. In comparison, secondary transports are the transportation of patients from one medical facility to another. Open transport systems allow direct patient management with the use of PPE by patient and emergency medical personnel throughout transport (Albrecht et al., 2020). Closed transport systems, which utilize patient isolation units, separate patients from emergency medical personnel during transport (Albrecht et al., 2020).

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Transportation involving the emergency medical system is different from that of policing. EMS transports are patient-focused in ambulances, while for law enforcement, it involves transports of arrestees or prisoners in police vehicles. The available research focused on EMS systems of transport and did not involve the transport of arrestees or prisoners by law enforcement.

Key & Consistent Findings

The collected literature's primary finding was the preference of land ambulances as the primary method of transport for COVID-19 patients. Ground transport is preferential due to the capacity for adequate air changes per hour and the separation of compartments to minimize the number of possible first responder personnel exposures. Data gathered from six air ambulance providers across Europe found that ground transport was the preferred mode of transportation in primary missions (Hilbert-Carius et al., 2020). Greater rates of air changes per hour reduce the risk of airborne infection. Land ambulances are capable of 24 air changes in the cabin per hour. This is 12 air changes per hour greater than the Centers for Disease Control and Prevention's minimum recommendation (Tien et al., 2020). Front driver compartments of land ambulances are often separate from the patient compartment, reducing the number of personnel exposed to infection risk (Mazzoli et al., 2020; Tien et al., 2020).

Emergency medical land and air transportation can be completed using open or closed transport systems. During secondary transports involving open systems, medical personnel may become physically and mentally exhausted due to the stress of avoiding accidental disease transmission and working in full PPE (Albrecht et al., 2020; Hilbert-Carius et al., 2020). Closed transport systems significantly reduce the burden of transport on transportation medical personnel because they do not need to wear full PPE (Hilbert-Carius et al., 2020). Using patient isolation units decreases transportation times, as they do not require additional decontamination of aircraft between transports, which has made them increasingly popular for COVID-19 patient transfers (Albrecht et al., 2020; Hilbert-Carius et al., 2020). The advantage of patient isolation units and the positive impact on transportation during COVID-19 was a significant discussion in the collected literature.

Difficulty in hospital acceptance has significantly impacted ambulatory service transports during COVID-19. Patients transported for acute disease experienced an increased proportion of difficulty in hospital acceptance from March and into April 2020 compared with proportions of difficulty in 2019 (Katayama et al., 2020). Ambulances have struggled to deliver patients to health facilities due to lengthy ambulance queues, some waiting more than an hour to discharge their patients to the hospital (Gulsen et al., 2020; Fagoni et al., 2020). Increases in ambulance diversion have been previously documented in pandemics such as the H1N1 2009 Influenza (Tsubokura et al., 2010) and community influenza outbreaks (Schull et al., 2004).

The COVID-19 pandemic has significantly changed the number of patient transports. Research found ambulatory services experienced a decrease in the number of patient transports several weeks into 2020 compared to the same period in 2019 (Fagoni et al., 2020; Gulsen et al., 2020; Katayama et al., 2020). Fagoni et al. (2020) report that in the Lombardy region of Italy, there was a 481 percent increase in patients who refused or were denied transport to the hospital in March 2020 compared to March 2019.

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Gulsen et al. 2020 reported similar findings in Antalya, Turkey, where transfer refusals were an average of 11 percent higher during the COVID-19 outbreak than non-outbreak. The suggested reasons for such decreases include fear of COVID-19 exposure during transfer or in hospital (Gulsen et al., 2020; Katayama et al., 2020), an increased public concern for emergency medical care providers safety (Katayama et al., 2020), and the selection of patients based on the severity of need due to overcrowding of hospitals (Fagoni et al., 2020). There was no research available in the collected literature that addressed changes in transport for law enforcement or fire rescue.

Research Design & Limitations

Research designs utilized in the relevant studies included retrospective studies (Fagoni et al., 2020; Gulsen et al., 2020; Katayama et al., 2020; Tsubokura et al., 2010;), literature reviews (Albrecht et al., 2020; Bredmose et al., 2020; Mazzoli et al., 2020; Tien et al., 2020), and international surveys (Hilbert-Carius et al., 2020). The first responder population of interest in these studies was emergency medical personnel. Research addressing land ambulances was primarily retrospective studies (Gulsen et al., 2020; Fagoni et al., 2020; Katayama et al., 2020; Tsubokura et al., 2010). Research addressing emergency medical air transportation was conducted through literature reviews (Albrecht et al., 2020; Bredmose et al., 2020; Tien et al., 2020) and international surveys (Hilbert-Carius et al., 2020).

Interventions

One of the concerns of first responders during transport was emergency medical personnel training in PPE utilization. Land ambulances and emergency medical air transportation require medical personnel to work with a minimal amount of space. Staff needs experience applying, wearing, working in, and disposing of PPE under these conditions (Bredmose et al., 2020). Of the six air ambulance agencies included in Hilbert-Carius et al. (2020) discussion, zero crew members reported COVID-19 infections. Their success is attributed to developing special procedures, safety instructions, and training. The topic of training is elaborated on in Section XV (Training).

Needed Research

There was no mention of law enforcement or fire rescue in any of the collected literature regarding transportation. In particular, pandemics such as COVID-19 have significant implications for the transportation procedures of law enforcement. There are several discussions that need to be considered, including the contamination and sanitation of law enforcement vehicles, effective methods for transporting one or more civilians that minimize the risk of exposure, and procedural changes to transportation that law enforcement has adopted due to COVID-19. Research is needed to understand how COVID-19 has impacted first responders' transportation efforts more generally.

Another area of needed research is how transportation procedure changes have impacted first responder personnel's ability to perform and complete their job tasks. The present literature briefly discusses efforts to minimize the number of personnel exposed to potential or known COVID-19 patients by reducing the human resources responders can rely on during a response event. The impact of such efforts is a topic worth further investigation.

More research is also needed to identify the cascading impact of increased transportation times on the EMS system. For example, if an ambulance is delayed by three hours, it would be important to assess how this impacts that organization because it is not in service. We should also study whether this translates into additional delays for other organizations relying on that ambulance. There also needs to be a discussion on how transportation procedures were developed and implemented and where best practices were identified.

XIV. Human Resources

There are two primary areas where organizations have to deal with the pandemic at the policy or administrative level – (1) through their delivery of service and separately (2) how they manage their personnel, finances, and administrative functions to deliver those services. For example, an EMS company has EMTs and paramedics that respond to calls involving infected patients and transfer those in need to hospitals. They also have management structures that ensure that EMTs are paid, that the ambulance works, and that there is enough staff on hand to respond to requests for service. This section focuses on this second area of work: non-service delivery-related policies tied to funding and human resources management. Service delivery-related research are documented in Section IX (Service Delivery and Productivity).

Human resources are the primary mechanisms through which organizations will be dealing with the direct effects of COVID-19 and necessary to ensure that service delivery, staffing, and deployment changes can be implemented.

While human resources, logistics, and personnel management are less glamorous than responding to calls for service, they are essential to these first responder organizations' functioning. Only a limited number of sources describe some current potential impacts and changes due to COVID-19 and various research from other long and short-wave events (Gershon et al., 2010; Goodman & Mann, 2008), but with our collected literature, we did not gain a full picture of this topic.

Key & Consistent Findings

We first describe the limited currently available research relating to the impact of COVID-19 on human resource-related policy, which prominently features work from Lum et al. (2020A; 2020B) and Police Executive Research Forum (PERF) (2020C). In part two, we focus on factors organizations should consider when making sure that first responders are willing and able to work during a disaster with some specific focus on human resources functions.

Impact of COVID-19 on Human Resources. There are a variety of data streams currently being collected through the International Association of Chiefs of Police, National Police Foundation, and the International Association of Chiefs of Police regarding COVID-related impacts. However, research reports based on these data outside of Lum et al.'s (2020A; 2020B) surveys of law enforcement in the United States and Canada are scarce. Hopefully, findings related to these studies will be published in the near future.

Anecdotal evidence from PERF indicates law enforcement organizations are implementing a variety of changes to human resources over the course of the COVID-19 pandemic. These changes include implementing personnel safety precautions, suspending training, adjusting roll call briefings, limiting access to facilities, encouraging personnel to work remotely, modifying schedules of key personnel, keeping employees separate, increasing emotional wellness programs, and making accommodations for working parents (PERF, 2020C). Regretfully, less is known about these programs' effectiveness and any positive or negative unintended effects of their implementation (PERF, 2020C).

In a survey of member organizations, PERF found that 48 percent of agencies report that their budgets will be decreased or are likely to be reduced in the next fiscal year (PERF, 2020C). Larger agencies report they were more likely to have cuts (PERF, 2020C). Of reporting agencies, the reporting they were anticipating cuts between 5 percent and 10 percent (PERF, 2020C). The most frequently cited areas where these cuts would be applied are equipment, training, hiring, and overtime.

Lum et al. (2020A) asked questions related to remote working policies, personnel exposure, and funding losses in their two-wave survey. They found 74 percent of responding agencies reported having a plan in place to monitor personnel on sick leave and quarantine (Lum et al., 2020A). These agencies also report shifting civilian personnel to remote work, with 60 percent reporting some shift to remote work and a small percentage (11%) moving more than nine in 10 workers to remote (Lum et al., 2020A). Lum et al. 2020B also roughly similar work levels from home for civilians but decreases in the number of hours civilian employees worked. Interestingly, organizations report being more confident about handling officers exposed in the field than in Wave 2. Despite this increased confidence, they also report anticipated budgetary concerns, with approximately one in three agencies reporting a less than 10 percent reduction, one in three anticipating a 10-20 percent reduction, and one in four expecting budget losses of more than 25 percent (Lum et al., 2020B, p. 2). Respondents indicate these budget cuts would impact staffing (31%) and capital improvements (25%).

Willingness to Work. During disaster situations or pandemics, the willingness of first responders to report for duty is essential. If fire, rescue, EMS, or police organizations do not have enough personnel, they cannot provide adequate services during a community's time of need. In various studies, first responders report some degree of unwillingness to work in health or natural disasters. In one study, approximately 12 percent considered early retirement if a severe pandemic outbreak occurred (Gershon et al., 2010: p. 1001). First responders are also reporting being less willing to work for non-conventional disasters (Noble et al., 2014; Tippet et al., 2009), such as pandemics compared to natural disasters. While Alwidyan et al. (2020) report increased concern among EMS personnel in responding to disease outbreaks, they do not find a reduced willingness to work. Rutkow et al. (2014) report that EMS personnel in states which allowed emergency declarations were more willing to respond to an influenza pandemic.

First responders have a reasonable expectation that they should be safe and prepared for their jobs in high-risk situations. Willingness to work generally involves two components: (1) if the ability to report for work is based on physical and mental health, familial or legal obligations, and (2) if willingness involves voluntary intentions to report for duty (Gershon et al., 2010). In short, ability involves someone

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who can work, and willingness involves showing up to work. A first responder may be unwilling but able to work, or vice versa. First responders' concerns about their safety and their families' safety impact their decision to come to work (Goodman & Mann, 2008; Gershon et al., 2010; Rebmann et al., 2014).

The willingness of EMTs and Firefighters to work during health or disaster scenarios has been subject to study, but less is reported about law enforcement's willingness to work. Gershon et al. 2010 found that 53 percent of police, 52.7 percent of fire, and 49.7 percent of personnel able and willing to report for their duty or increased duty during a pandemic outbreak. Most available research was focused on EMS personnel. Tippet et al. (2009) found similar levels in a study of Australian EMS personnel. Qureshi et al. (2013) found a somewhat higher willingness to work in a study of Hawaiian public employees, including first responders. Similarly, an online survey involving 1,566 employees of a major German city suggests that up to 20 percent of the public service workers were unwilling to come to work during an influenza pandemic (Gottberg et al., 2016). Gottberg found willingness to report to work was increased by the perception of a high working role competence, a high assessment of role importance, high self-efficacy expectations, and a heightened sense of duty (Gottberg et al., 2016).

In a survey of fire, police, and EMS personnel in Austin, Texas, Noble et al. (2014) found variation in willingness to work across first responder groups by disaster types. For example, police personnel reported they would respond 87.2 percent of the time to a 5-7-day weather event and 68.6 percent for an incident lasting 14 days (p.8). Fire employees report 92.6 percent would report for a 5-7-day event and 82.6 percent for a 14-day event (Noble et al., 2014, p. 8). In a question about working in a highly contagious disease outbreak, there also existed variation with 60.1 percent of police, 58.8 percent of fire, and 75.5 percent of EMS personnel indicating that they would be willing to respond.

First responders report their willingness to work is increased by a variety of other factors. Family obligations are reported as having a significant impact on willingness to work (Gershon et al., 2010; Noble et al., 2014; Qureshi et al., 2013; Tippet et al., 2009); in particular, those with greater family obligations have less ability to work during a crisis, for obvious reasons. In a similar study of first responders in Hawaii, 81 percent reported a willingness to work additional shifts during a pandemic, they noted high levels of competing obligations, which might impact the ability to work those shifts (Qureshi, 2013, p. 8).

Willingness to work is often tied to trust in the organization (Gershon et al., 2010; Qureshi et al., 2013). Trust in employers is connected to a willingness to work and the use of PPE. In a survey of Australian EMS personnel, Tippet et al. (2009) found a strong relationship between preparedness to wear PPE and confidence in their employer. Availability of PPE also increases willingness to work (Gershon et al., 2010; Tippet et al., 2009). First responders concerned about having enough PPE were less willing to return to work in a hypothetical scenario (Alwidyan et al., 2020).

A Focus on Human Resources. Human resources are essential to organizational functioning and play a primary role in communicating with personnel, making sure people are available to work, and paid for their work (Goldman & Mann, 2008). In this section, we focus on the vital role of human resources personnel in maintaining an organization's ability to provide services during a disaster. While some

studies made mention of human resources policies as essential to organizational trust and willingness to work (Gershon et al., 2010; Qureshi et al., 2013; Tippet et al., 2010;), they did not specifically study or articulate human resources activities of importance to the response to long or short-wave events. Only Goodman and Mann (2008) had a specific focus on this topic.

Goodman and Mann (2008) conducted a series of semi-structured interviews following hurricane Katrina in Mississippi. It represents one of the few studies that directly focuses on first responders' human resources policies dealing with a long or short-wave event that we identified. Through their interviews, participants supported the importance of designating human resources personnel as essential workers. Human resources personnel can help organizations manage and deploy personnel throughout a disaster and when they are willing and able to come to work. One example of how incorporating human resources into the emergency response is exhibited in payroll functions. Goodman and Mann (2008) report that a number of organizations had issues with processing payroll due to internet outages and damaged hardware. Organizations overcame these issues through several prepositioned strategies, including paying people ahead of time, in cash, or partnering with communities outside of the disaster area who use the same HR software and payment systems (Goodman & Mann, 2008).

Organizations also report various long-term impacts of disasters on human resources, specifically, and on organizations, more generally. Respondents indicate financial cuts in the long-term impacting organizations; communities often managed these cuts through attrition (Goodman & Mann, 2008). While many organizations report an issue with recruitment and staffing due to competition for skilled and unskilled labor, this may be less relevant due to the COVID pandemic's nature. Unlike many natural disasters, damage to infrastructure and property is more limited. Goodman and Mann (2008) also report increases in employees requiring employee assistance and stress-related issues, indicating that local-level employees like first responders are responding to the pandemic and affected by it on a personal level. While Goodman and Mann (2008) studied the impact of a short-wave event, recovery was a long-term process and depicts how human resources affect first responders' ability to work.

Interventions

Interventions and policies related to administrative functions and willingness to work can come in a variety of forms. Organizations can establish policies and systems that foster or improve personnel's willingness to work during a pandemic or disaster scenario. Organizations can develop and build trust in various ways, including through preparedness plans and having clear human resources policies during disasters (Gershon et al., 2010; Tippet et al., 2009).

Organizations can also ensure the provision of proper levels of training to increase willingness to work. While this intervention is covered in more detail in Section V (PPE Use and Availability), research studies consistently find that training in PPE use and infection control can lead to increased willingness to work for EMS personnel (Alwidyan, 2020; Alwidyan, 2007; Gershon et al., 2010; Le et al., 2018; Tippet et al., 2009).

Organizations should help their personnel to meet familial obligations such as childcare, family care, or other personal obligations. Gershon et al. (2010) also report that organizational-level factors such as

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preparedness planning and training for respiratory protection, the establishment of a pandemic emergency plan, and available PPE increased personnel's willingness to work during a pandemic

Keeping personnel paid and accounted for should also be considered essential components of any broad administrative policy or interventions. Goodman and Mann (2008) report having a clear organizational chart, clear responsibilities, and supervisor redundancies are critical across and within organizations. Human resources should also be added to the emergency management team (Goodman & Mann, 2008).

While more fully described in Section VIII (Testing and Vaccines), sponsored vaccination programs can also provide some distinct benefits to organizations. For example, if first responders are subject to physical screening requirements on a routine basis, organizations can put in place efforts to increase vaccine acceptance. Glaser et al. (2011) studied the voluntary seasonal influenza vaccination program's impact tied to an influenza pandemic preparedness drill. This program was free to personnel, conveniently offered, and supported by labor and management (Glaser et al., 2011). During the program, acceptance rates for vaccination were 57.2 percent compared to 34.2 percent during annual medical visits (Glaser et al., 2011, p. 4).

Needed Research

Research in this area needs to focus on both administrative impacts and moderators of those impacts and personnel's willingness and ability to come to work. An in-depth review of how first responder organizations manage their response to COVID-19 from a human resources perspective is needed. It would also be essential to identify healthcare and testing-related costs that organizations are experiencing over time, as these findings will help budgetary planners as well as managers tasked with addressing the current and preparing for the next pandemic.

Many of the studies associated with willingness to work are based on surveys of 1,000 or more personnel across multiple locations and multiple periods – including Hawaii (Qureshi et al., 2013), Australia (Tippet et al., 2009), Jordan (Alwidyan et al., 2020), and the United States (Gershon et al., 2010). These findings can therefore be considered relatively consistent. However, an overarching concern with many of these studies is that they do not report actual behavior during a pandemic emergency; they focus on intentions. Therefore, as we seek to understanding the current COVID-19 pandemic, it will be important to study factors affecting the willingness and ability to work, and to identify levels of failure to report for duty wherever possible.

Studying factors affecting willingness and ability to work during the COVID-19 pandemic, combined with learning how willingness and ability led to actual behavior, are also needed. On a related note, many aspects of organizational trust and how this trust relates to willingness to work relate to trust by the organization's personnel *before* (emphasis added) an event occurs. As the pandemic event is long wave, it may also make sense to gauge factors affecting organizational trust *during* (emphasis added) a pandemic and how these and related factors change over time. Undoubtedly, first responders' willingness and ability to come to work will change over time based on factors inside and outside their employers' control. It would be important to study those factors.

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Guidance documents outline several potential recommendations that organizations can implement to protect personnel on the job, including screening, limiting visitors to the station, moving from multiple occupancies to dual occupancy bunk rooms or vehicles, or modifying exercise routines (Katzer, 2020). While all reasonable, research or at least some modeling to support the use of these personnel management related recommendations would also be useful.

XV. Training

The focus of this section is the benefits of infectious disease and PPE-related refresher training. Only limited research was available about training more generally and less on general training such as recruit or academy training or the impact of COVID-19 on other ongoing training requirements of organizations such as academy training or routine training. In a survey of wildland fire organizations, Stoof et al. (2020) found reports of a negative impact of COVID-19 on training (Stoof et al., 2020), but no more detail was available.

Lum et al. (2020A; 2020B), also reports COVID-19 impacting police training academies, but findings are also limited. In Wave 1 of their survey, Lum et al. (2020A) reported several interesting findings related to training. Of their respondents, 34 percent had suspended academy training, 18 percent suspended in-person and moved online, 35 percent had *not* suspended academy training (Lum et al., 2020A). In Wave 2 of their survey, a similar percentage of agencies report stopping their academy as Wave 1 (Lum et al., 2020B).

Key & Consistent Findings

In the collected literature, training concerning the current pandemic is of particular relevance to the transmission of COVID-19 and the proper usage of PPE. The use of PPE by first responders is critical when vaccines or other treatments are unavailable. It is one of the primary mechanisms through which it is possible to limit illness among first responders and prevent them from being carriers and spreading to their co-workers, family, or other community members (Pradhan et al., 2020). Training in the use of PPE is tied to a variety of decisions by first responders, including a willingness to work during a pandemic, compliance with PPE usage requirements (limiting potential downstream direct effects on personnel), the likelihood of getting vaccinated, and willingness to provide care to highly infectious persons.

Throughout the collected literature, there is a consensus that additional training is needed for first responders on infection control and the proper usage of PPE. In a variety of collected literature, the need for training is called out for pandemics in general (Abatemarco et al., 2007; Gottberg et al., 2016; Jessop, et al., 2014; Mahomed et al., 2007; Richards et al., 2006; Shaban et al., 2003), disaster situations (Bernard et al., 2006), collection of hazardous specimens (Kelly et al., 2007), and COVID-19 in particular (Gibson et al., 2020; Heber et al., 2020; Ren et al., 2020; Stoof et al., 2020). Knowledge of infectious disease symptoms are essential because EMS personnel may be the first to evaluate a patient (Le et al., 2018).

In a small sample survey of EMS personnel, Gibson et al. (2010) found that 38 percent of EMS personnel report receiving no training in COVID-19 response, and 50 percent reported only limited training (510).

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In a survey distributed from 2018 to 2019, Rebmann et al. (2020) found 26.8 percent of EMS personnel received no pandemic training, and only 14.3 percent had participated in a pandemic exercise. These researchers also found that 39 percent of responding EMS personnel were unsure when COVID-19 infected patients were infectious (Gibson et al., 2020, p. 510). While Gibson et al.'s sample was small, it is not in contrast to other research. Le et al. (2018) found that approximately one-third of respondents reported not receiving an annual or continuing education training in highly infectious diseases, indicating a need for additional training. Shaban et al. (2003) also found paramedic knowledge of infectious disease causation and transmission was low and problematic. This lack of training in PPE is not a recent phenomenon. In a 2002 study focused on preparedness for both weapons of mass destruction (WMD) and pandemics, Reilly et al. (2002) found 54.8 percent had received training in biological agents and 57.5 percent in decontamination in the prior 24 months. Qureshi et al. (2013) also found 63 percent of the responding group of public services workers (which included first responders) received no training on respiratory protection.

The impact of training on willingness to work is also consistent: there is a reliable positive relationship between the two. In a study involving Jordanian EMS providers, Alwidyan et al. (2020) found that the better trained and prepared personnel were, the more likely they were to be willing to report to work during a pandemic. Those who did not feel they were provided adequate training were less willing. Alwidyan (2007) also found similar results among a similar sample of EMS personnel in Delaware. Le et al. (2018) found responding EMS personnel had a lack of confidence in their ability to respond to a highly infectious patient and a desire for more preparedness. Tippet et al. (2009) found similar results in a survey of Australian EMS personnel and Qureshi (2013) among first responders in Hawaii.

Gershon et al. (2010) reports similar concerns and found their refresher training resulted in slight increases (3%) in willingness to respond during a pandemic (p. 510). In a related vein, Le et al. (2018) found differences in preparedness based on EMS responders' position. They found willingness to respond to highly infectious diseases (like EBOLA) higher with paramedics than with personnel with lower training levels, such as EMTs. Paramedics are typically the most highly trained emergency medical personnel (Le et al., 2018).

Research Designs & Limitations

There is a mix of research designs associated with these studies; they range from international surveys (Stoof et al., 2020) to country-level organizations, such as the Jordanian Civil Defense system (Alwidyan et al., 2020) an ambulance network in Australia (Tippet et al., 2009) or the FDNY (Gershon et al., 2010) or limited samples across the United States (Le et al., 2018). Le et al. (2018) allowed for the differentiation at the front-line and leadership/supervisors. In most of the studies, the sample involved emergency medical personnel or firefighters; few if any of the studies focused on police. Many of the training studies involved pre and post-assessments both of reaction to the material as well as knowledge regarding the training topic (Gershon et al., 202010; Reilly et al., 2002; Suppan et al., 2020), but only one involved follow-up over time (Northington et al., 2007).

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Interventions

Across the collected documents, interventions and evaluations provide avenues for future research and possible interventions that might be of use to first responders during the current COVID-19 pandemic. Research consistently indicates training involving infection control, and the use of PPE has beneficial outcomes. However, there are some indications that the more simulation or practice-based training an approach is (rather than a lecture), the more useful trainees report training (Marrs et al., 2019; Rielly et al., 2007; Suppan et al., 2020).

Abatemarco et al. (2000) conducted a train-the-trainer training evaluation study and measured knowledge gain and perceptions of bioterrorism events and preparation with a cadre of volunteer firefighters. They found modest but significant increases in trainee confidence in using masks during biological events and their knowledge about specific PPE protective factors (Abatemarco et al., 2020). Rielly et al. (2002) also found that EMS providers given more hands-on training felt more prepared to deal with chemical, radiological, or biological disasters. An influenza-based training program involving New York City firefighters found a 30-minute refresher training increased knowledge, the ability to identify specific flu-like symptoms, and increased willingness to get vaccinated (Gershon, 2009, p. 510). Scarborough et al. (2007) found no new needle stick injuries and reduced pathogen exposures among the new EMS recruits trained during the training period from PPE and infectious disease training developed in collaboration with a hospital system. Regretfully, only limited information is available about Scarborough et al.'s (2007) methodological approach. In a recent study involving online refresher training focused on the COVID pandemic, Suppan et al. (2020) found that refresher training in any form increased knowledge regarding PPE use.

While training can have a positive impact, an essential concern with any training intervention is decay. In a study evaluating trainee ability to retain skills and necessary knowledge to use chemical-resistant PPE (Level C), Northington (2007) found significant deterioration in the ability to don and doff PPE properly. Immediately after the study, 100 percent of trainees could successfully take on and off the Level C PPE. Six months later, 85.7 percent could *not* (emphasis added) do so without a critical error (Northington et al., 2007, p. 848). While Northington et al.'s (2007) sample was in training and not yet working as emergency medical personnel, it still emphasizes the need for repeat refresher training.

Overall, this combined research indicates a potential need for and clear benefits to short and routine refresher training in infectious disease control and the proper use of PPE. Having the proper PPE is not the same as knowing how to use the PPE correctly. Reilly et al., 2007 found while first responders reported having the PPE, they were often not trained. Training in performing operations while wearing PPE can be essential due to the complexity of conducting specific tasks while wearing them (Reilly et al., 2007).

Needed Research

This review identified several potential limitations and avenues of research. One limitation in the existing literature is the lack of in-depth studies recording the actual impact of PPE refresher trainings on practice and any subsequent benefits down the line on how this training reduced illness among personnel or

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mission outcomes. While willingness to work was an element to many studies, none involved studying behavior during a pandemic; only perceived willingness to work during a hypothetical event.

There also exists questions regarding how much training over what period is necessary for PPE-related refresher training or how to limit the decay in PPE related skills and infection control. While Lum et al. (2020A; 2020B) reports law enforcement organizations provide their personnel training and guidance in infection control and PPE usage, we do not know the frequency, approach, or benefit of this training. While many of the studies had sample sizes from 1-2,000, none were considered representative of first responders across the United States. Le et al. (2018) indicate that large-scale surveys would be better received (and lead to higher response rates) if the survey were to come from prominent national EMS associations. National EMS associations should perform these evaluations, as should their counterparts in fire and law enforcement. More research is also needed to understand compliance with PPE-related mandates across first responder groups. Few or no studies have explored willingness to work in the COVID-19 pandemic or focused on PPE trainings for law enforcement.

Limitations

Our approach has several limitations. These limitations relate to the timeline for collection of relevant research, the specific search engines and key terms which drove our collection, the broad nature of our mandate, and the groups outside of the first responder community which were outside of our scope. Each is described in greater detail independently below.

First, the timeline for the collection of literature was between September and October 2020. As this is an ongoing event, research will continue. Additional literature has been published since that time that may fill in some of the gaps identified in this document. Findings outlined in this document should be considered cross-sectional.

The seven search engines and specific search terms utilized in our collection approach narrowed the scope of our collected literature. The key terms utilized in our search dictated the literature we found and subsequently reviewed. While we intended to cast a wide net in the search processes, relevant research may have been missed.

Our focus was research associated with long and short-wave events and their potential impacts on fire, police, and emergency medical services. This is a broad mandate, limiting our availability to conduct an in-depth review of any given topic. While this scoping review allowed us to identify multiple sub-themes related to each topic, it was impossible to conduct an exhaustive review of each. In effect, we had to triage what was the most potentially relevant, actionable, or broadly studied.

The focus of our review was fire, police, and emergency medical services. A myriad of other organizations interact with these first responder organizations and provide services to the community, which are important but outside the scope of this project. These include community volunteers, emergency managers, corrections officers, and other government agencies.

Despite these limitations, we believe this document will provide benefit to researchers and practitioners which seek to monitor and mitigate the impact of COVID-19 on first responders.

Discussion

In this document, we reviewed the potential environmental, direct, and indirect effects that COVID-19 might have on first responder organizations. The documents reviewed here are related to identified effects of short and long wave events on fire, police, and emergency medical services. This is a broad body of literature with a myriad of important findings.

This review provides a number of important takeaways. First, the impact of the COVID-19 pandemic is multi-dimensional. Several job types and aspects of the work of first responders have been altered since March 2020, including risk of illness, absence, changes to service delivery, PPE requirements, the way people communicate, and how organizations train and manage their personnel.

Importantly, these varied changes interact with one another, and a change at one level can result in meaningful downstream consequences (e.g., increased demand leads to exposure among personnel, which results in staffing shortages; or public health mandates slow service delivery which results in mental health repercussions). Acknowledging the interconnectedness of these changes will be essential to formulating comprehensive responses that support first responders in the near term and prepare organizations for the remainder of this outbreak as well as the next one.

Organizations are feeling a broad number of environmental effects. In combination with other social and economic unrest tied to the pandemic, police organizations are dealing with increased levels of crime (Boman & Owen, 2020; Leslie & Wilson, 2020; Mohler et al., 2020; Rosenfeld & Lopez, 2020; Sutherland et al., 2020). EMS and fire organizations are also responding to more complex demand for their services due to COVID (Fagoni et al., 2020; Friedman & Stayer, 2020; Lerner et al., 2020; Slavova et al., 2020). Concurrently, organizations are also experiencing funding reductions which may hamper their operations in the future (Lum et al., 2020B; PERF, 2020C). While the various pushes and pulls on organizational demand are multi-faceted, it is clearly a more complex landscape for the work of first responders.

First responder personnel are also getting exposed and infected, becoming ill, and even dying from COVID-19 (Anderson et al., 2020; Baker et al., 2020; Guo et al., 2020). Organizations are experiencing changes in demand in the face of staffing issues. They are likely to be experiencing emotional strain and fatigue because of the long-wave nature of the pandemic (Heber et al., 2020; Stogner, Miller, & McLean, 2020). While more research is needed to determine the levels of exposure, quarantines, absenteeism, extended medical leave and mortality, direct effects are a clear challenge to first responder organizations.

Organizations also report significant changes in their service delivery and human resources (indirect effects) due to COVID-19 (Lum et al., 2020B). Organizations report limiting in-person responses and limiting enforcement of low-level offenses to restrict contact between officers and citizens (PERF, 2020B). To limit exposure, organizations are reducing the number of personnel in vehicles (Stoof et al., 2020).

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Organizations are also taking a variety of efforts to limit the impact of COVID-19 on their personnel and organizations. These interventions range from how calls for service are dispatched (Kristal et al., 2020; Marrazzo et al., 2020), to how they have personnel utilize available PPE (Ventura et al., 2020), and to how they deploy personnel in response to requests for service (Lum et al., 2020B). Regretfully, less is known about the effectiveness of these service delivery changes and interventions and whether their implementation had unintended consequences.

The overall impact of the pandemic on first responders has yet to be measured. We will not know the true extent of the pandemic's effects on organizations until after it is over and we have the opportunity to more clearly study the pandemic in hindsight.

Research to Practice

Our project team includes subject matter experts who were upper-level managers in large first responder organizations. To identify the potential relevance of our findings and highlight additional gaps and needs we asked them to review an initial version of this document. They had a variety of specific concerns and recommendations which are outlined independently below.

Operational Costs. From an operational standpoint, financial impacts are a significant concern for first responder organizations. While employee and community health are the primary concerns these are also manifested in increases in unbudgeted expenses. While costs are referenced in this document, there is insufficient information to evaluate its impact on operations. Organizations are incurring a variety of unplanned for and unforeseen cost. An example would include the time needed to decontaminate vehicles and equipment following a COVID-19 exposure. Decontamination costs range from the length of time a vehicle is out of service, the effort to clean the vehicle, and the materials needed to conduct the cleaning. Other unexpected costs would include maintenance of PPE and replacement costs. Organizations also face an increase in personnel costs related to paying first responder personnel to include events like mandated quarantines to funding additional personnel (likely on overtime) to ensure adequate staffing is available to meet community needs. Overtime is likely to have been accrued in large quantities in order to maintain sufficient coverage. It would be essential to better understand those costs and how to reduce them now and in the future.

Unit Availability. In practice, agencies have historical references for approximated response, arrival and clear times for frequently encountered calls for service. For example, a call involving a car accident with minor injuries may mean that an EMS unit is out for service delivery for a predictable amount of time. However, based on this review we still do not know how long a unit will be out for service delivery on a COVID-related call, especially if there is a decontamination process involved once the call is completed.

Organized Labor. Personnel costs are one of the main budget items for any first responder organization. In many large municipal organization's personnel are represented by organized labor. The relationship between labor and management during the pandemic, how they communicate, and manage changes to labor practices is paramount to the ability to deliver services. Prior to the pandemic, organized labor likely had no provisions in existing contractual bargaining agreements related to pandemics. For example, there were probably not pre-existing terms that distinguished how a mandatory quarantine due

to on-the-job exposure should be accrued and whether that time off is accounted at the individual or organizational level. At the beginning of the pandemic, significant areas of concern between unions and organization management included how to ensure first responders were getting paid for COVID-related time off, and ensuring personnel was not being penalized for being put on mandatory quarantines. The methods that unions and organization management used to settle disputes related to these concerns is a topic of interest that should be investigated as contractual bargaining agreements can be a big part of how human resources are managed and services provided for by first responder organizations.

The Role of Emergency Management. While recognizing that the sphere of emergency management was outside the scope of this document, the role of offices of emergency management should not be discounted. They are intended to relieve a system when it is overwhelmed. During an event such as a COVID-19 pandemic, the resources necessary to conduct operations by first responder organizations is often greatly expanded beyond their typical scope. Offices of emergency management (OEM) function as an intermediary between agency and resource suppliers, relieving the additional burden of dealing with some elements of the emergency response from first responder agencies. The utilization of Offices of Emergency Management and their impact on first responder organizations abilities to operate during the COVID-19 pandemic are integral to providing service in response to and during a pandemic and should be a focus of future inquiry.

The Role of Incident Command. Concise command and communication structures are important for first responder personnel who are deployed during emergency situations. The utilization of an Incident Command System (ICS) is one way of coordinating a command and communication structure during an emergency situation such as COVID-19. The ICS delegates tasks and responsibility so that each entity has a clear purpose and goal. The degree to which Incident Command Systems were utilized during the pandemic is unclear and worth investigation. If such systems were utilized, how effective they were and the difference in outcomes between first responder organizations who did or did not utilize ICS are also an important topic of relevance to this project. The degree to which prior training in incident command, or a lack thereof, impacted the deployment of first responders during the COVID-19 pandemic is another topic of interest.

The consultation with the subject matter experts informs how our future case studies, interviews, and staffing studies will proceed. Our project team will address these gaps in research and formulate the future research accordingly.

Informing Future Research

Through the drafting of this literature review, we identified several ways the collected findings, with subject matter expert input, can inform our current project to better account for gaps in research. Therefore, we thought it useful to highlight opportunities we can take as part of our own project to add to the scientific literature and fill in some of these gaps. As part of our project, we are conducting interviews with the first responder community and proposing to conduct case studies involving studying the impact of COVID on organizational demand, staffing, and service delivery over time. These approaches provide a variety of unique opportunities. Each is described in greater detail below.

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Preparedness Planning. As part of our case-study approach, we should seek to identify the extent to which organizations were prepared for the pandemic, the existence of preparedness plans, where those plans failed or were useful, and the changes they would make to these plans in the future. As part of this approach to preparedness planning it would also be possible to ascertain the role of offices of emergency management in the planning process and their role in response.

The Long Wave Event. As part of our interviews and case studies, we should seek to better capture this event's long-wave nature. First, it was difficult to disentangle the impact of the COVID-19 pandemic from the other political, social, and social unrest, including that tied to George Floyd's death in Minneapolis, Minnesota. Secondly, we should try and capture how the pandemic unfolded over time across jurisdictions. In a sense, while each community was facing similar situations, they did so at different times at different severity levels. Each community is also impacted by the decisions that surrounding communities make in their response to COVID-19. This variation needs to be captured.

Role Conflict and Willingness to Work. As part of our research, we should seek to better understand individual level staffing issues. These involve the study of role conflict, the extent first responders do or don't show up to work, how first responders overcome competing obligations, and how their ability and willingness to work has changed throughout the COVID-19 pandemic. Like all of us, first responders must maintain their familial and personal obligations while providing services over a lengthy period. Organizations will also respond differently to the pandemic and support their personnel differently, which will impact first responders' willingness and ability to come to work.

EMS and Fire Demand. In our case studies, we need to account for the fire departments' role in the provision of emergency medical services. In the collected research, it has been difficult to disentangle fire from EMS demand. Firefighters generally provide emergency medical services, but some EMS organizations are also strictly transport organizations and are not involved in emergency response. In our research, we need to account for how these two organizations overlap or interact in providing services and how each is impacted independently or concurrently by COVID-19. It would also behoove us to leverage the NEMSIS national EMS database to measure demand changes on the aggregate level. As part of demand, we can also determine unit availability due to COVID-related calls for services.

Human-Resources Focused. In natural disasters like hurricanes and tornadoes, there is likely to be not only injuries among the population abut also concurrent damage to buildings, roads, vehicles, and other non-personnel resources. However, in the COVID-19 pandemic, it is primarily a matter of human resources. The first responders might get sick, and the first who show up to work and provide services. In our case studies, we should focus on how organizations manage and maintain their personnel so that they are willing and able to provide services. A focus should also include collective bargaining agreements and communication between management and organized labor regarding COVID-related human resources issues.

Mental Health and Resilience. While more complex to study, we should not lose focus on first responders' mental health and what organizations and society can do to increase their resiliency and

focus on providing sustained levels of care over long periods. For our purposes, this could include additional questions in our interviewing and study the resilience of personnel as part of our case studies.

Measuring PPE Usage. As part of our case study approach, we should seek to determine the extent that compliance with the use of PPE led to COVID-related direct effects on personnel such as quarantines, exposures, and absenteeism. Paired with PPE usage, it would be useful to incorporate occupational exposure to COVID-19 over time and determine how it is tied to downstream effects on staffing and the organization more generally.

PPE "Refresher" Training. The research is fairly consistent that people get fatigued in their use of PPE and that training is essential to increasing both willingness to work and correct donning, wearing, and doffing of PPE. However, it would be useful to incorporate questions or measures related to how much and in what form PPE-related refresher training is or could be provided to maintain personnel's proper usage of PPE without burdening personnel.

Personal Experience of Service Deliverers. As part of our interviewing, we should expand our sample and modify our protocol to interview the first responder delivering service. These interviews will help us capture various factors, including role conflict and willingness to work, service delivery difficulties, mental health and stress associated with service delivery, concerns about vaccinations, and additional ways of helping these men and women be more resilient in the future.

Impact of Public Sentiment. Communities were asked to take unprecedented steps to enact social distancing and limit infections. The COVID-19 pandemic response has also become mired in politics and misconceptions. This created significant challenges. We should seek to gauge how first responders perceived these mandates and how they perceived their role in the enforcement of public health rules delivery during the pandemic.

Identifying Effective Guidance. As part of our case studies, we should seek to identify effective guidance. First responder organizations were recommended to make a variety of changes to how they deliver services during pandemics. For example, police took more calls over the phone and limited proactive stops, firefighters reduced the number of personnel providing patient care to limit exposure, and EMS changed their guidelines for the resuscitation of patients. While all potentially reasonable, we do not know the extent to which this suggested guidance was possible to implement or whether related changes in practice were effective based on their intended goal.

Transport. If possible, we should focus not only on emergency response but also on the follow-on provision of pre-hospital care and transportation to the emergency room as part of our case studies. We should specifically focus on identifying rational processes and approaches that effectively maintain patient care while ensuring the protection of the EMS personnel providing services in enclosed spaces such as ambulances.

Financial Considerations. Organizations will be impacted both in terms of current costs (overtime, testing, vehicle cleaning) as well as in future budgets. As part of our case study approach, we should seek

to identify additional financial costs and considerations over the course of the pandemic in order to help future planning.

Organizational Resilience. Organizational stress testing for preparedness, similar to the stress testing conducted on banks to ensure that a bank will withstand a fiscal crisis (Corporate Finance Institute, Obtained Online, 12/20/2020), is a critical concept for future research. Preparedness is not merely a factor of planning, but also involves the extent to which an organization has the relevant number of personnel, training, the available PPE, and stocks of supplies in case of a disaster event or another long-wave pandemic. We did not collect any research that directly discussed metrics associated with organizational resilience for operating during an extended pandemic. While outside the scope of our current effort, we propose the development of a standardized organizational preparedness self-evaluation system to help organizations rate their preparedness and identify gaps or improvements needed to function more effectively in future pandemics.

Conclusion

COVID-19 is having a significant impact on the functioning of first responders and first responder organizations. These potential effects involve the quantity and type of services organizations are being asked to deliver (environmental effects), threats to physical and emotional wellbeing of first responders (direct effects), and the subsequent compounding effects on organizations' ability to provide services and manage their human resources (indirect effects).

This document outlined our initial collection process and research review related to the impact of COVID-19, as well as short and long-wave events on first responders (police, fire, and EMS).

To date, our search has resulted in a wide variety of studies that cover multiple aspects of how first responders are impacted by COVID-19 and similar events from the recent past. While more research continues to be published on COVID-10, past crises (including natural disasters like Hurricane Katrina and infectious disease outbreaks like H1N1) can teach us a great deal about how first responders can successfully respond to the current crisis.

In this review, we sought to articulate consistent findings and to describe the content present and absent in different research areas. The current effort is helping to form an understanding of the research landscape related to COVID-19 and similar events, and will continue to serve as a resource for generating insights, shared understandings, new opportunities, recommendations and best practices for the first responder community.

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Appendix A: Codebook

Monitor & Mitigate the Impact of COVID-19 on Public Safety:

Literature Review Codebook Stages 1, 2, & 3

SECOND SIGHT TRAINING SYSTEMS, LLC
VERSION DATE: 9 OCTOBER 2020
2020

Introduction

This Codebook will assist you in the collection, review, and categorization of literature for the DHS-funded COVID project. It contains processes, variables, values, and definitions for all stages of the project. This Codebook reflects the three stages of the literature collection process:

1. Collection: the initial search and selection of relevant articles;
2. Secondary Inclusion: a secondary review of all relevant literature for inclusion in categorization, Stage 3; and
3. Categorization: coding collected literature based on relevance to the project and various other features.

This document also includes essential definitions, a short description about working with Zotero, exporting sources from search engines to Zotero, and setup requirements. Each stage is also described independently below.

Important Key Terms

There are a variety of essential definitions associated with this project. A list is included in Table 1.

Table 1. List of Important Terms

Term	Description
Metadata	The bibliographic data associated with each source (e.g., author, periodical name)
Codebook	This document
Source	An individual document such as a journal article
Search Engine	An online bibliographic search system such as Google Scholar or Pubmed
Browser	The web browser you are using to connect to the internet (Safari, Chrome, Explorer, Firefox, etc.)
Zotero	A bibliographic software
Zotero Connector	A browser plug-in that allows connection to Zotero.
Search Terms	The keyword combinations entered into the search engine when searching
Results	The outcome search of keyterms in a search engine
Export	The movement of an identified source from search engine results to Zotero
Group Library	The shared Zotero library associated with the project.
Library	The more extensive repository of collected sources for the project.
Folder	The file location in Zotero where sources are stored
Tag	A single word term used to code a document in the Zotero folder.

Working with Zotero

Zotero is a web and desktop based bibliographic software. For this collection and review process, you should be aware of several key features.

When you are looking at Zotero, there are three main components. Your Libraries (Item 1) in Figure 1. The sources in the Library (Item 2), and the source information or metadata (Item 3).
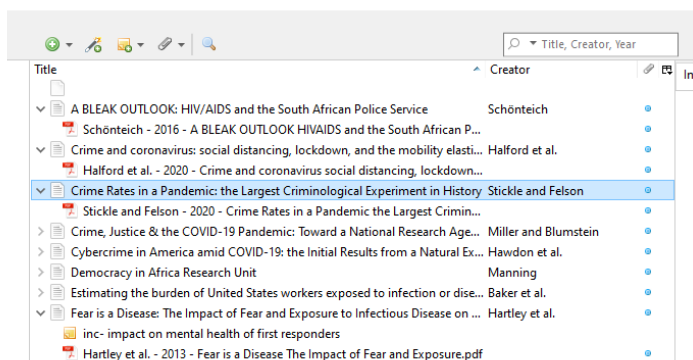
Figure 1. Zotero
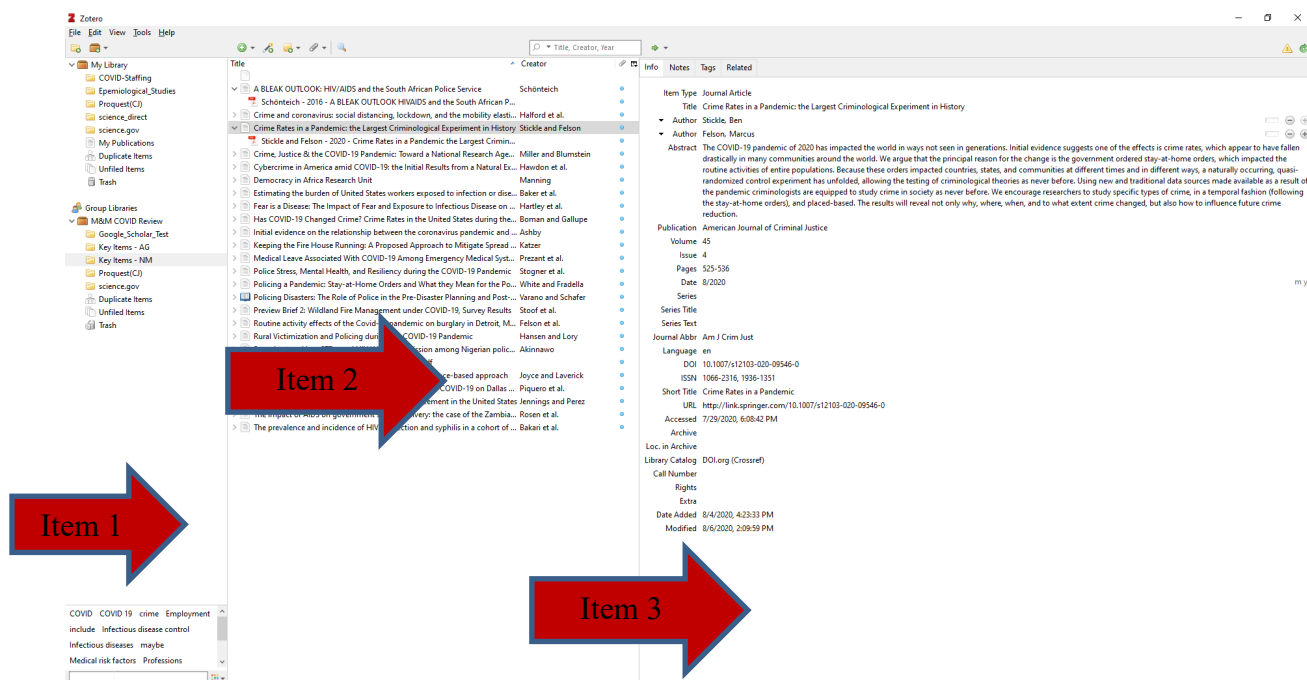
You will primarily be working in a single folder within a library, and therefore for your focus should be on Item 2 and Item 3.

Please take a look at Figure 2. Figure 2 is a depiction of a source list (item #2). You will note that you can see the title and author in the first line of the source. The full-text article in the second line (with a PDF icon), and also notes left by any of the project team related to that document below it (with a yellow/brown notepad icon).

Figure 2. Sources in the Library

Please also take a look at Figure 3. In Figure 3, we have the document metadata. The metadata includes all relevant bibliographic data that Zotero could extract. You will notice that each source has a four-part Dashboard (Info, Notes, Tags, Related). You will primarily be working with Info (the bibliographic metadata), Notes, and Tags.

Figure 3. Source Metadata
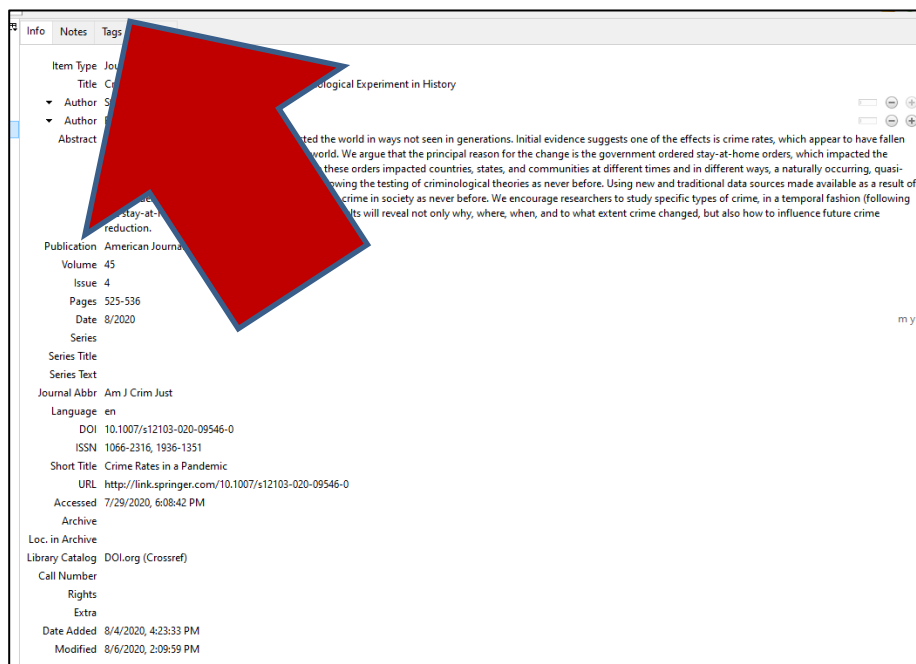
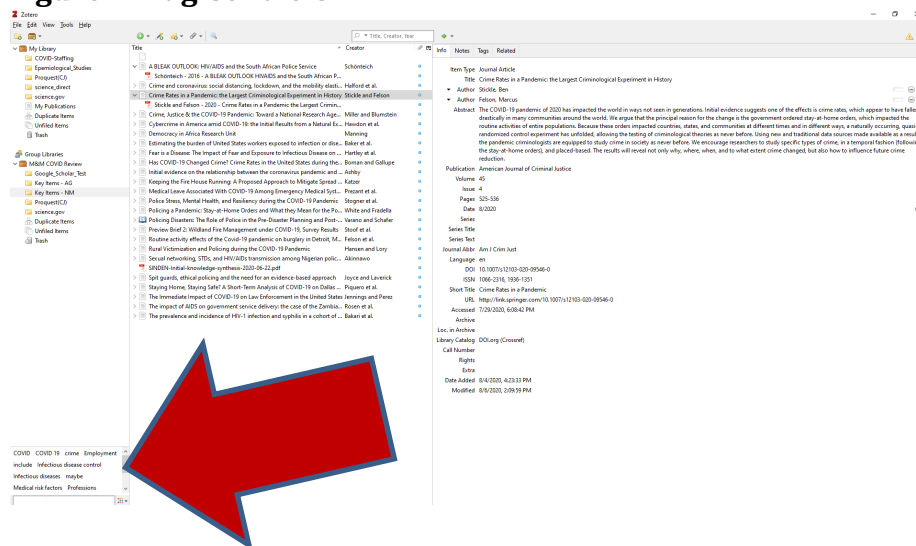You can also view the different tags associated with the Library in the bottom left-hand corner. You can toggle the various tags on and off by clicking on them. The tag location is depicted in Figure 4.

Figure 4. Tag Controls

Saving with Zotero

Search results can be exported directly to the online Zotero project library. Sources can be exported individually, or multiple sources can be exported at once. Please note, some platforms do not allow multiple sources to be exported concurrently (e.g., Science.gov), while others do (Google Scholar). Each saving approach is described below.

Exporting Articles Individually

1. Open the page with the associated references and click the puzzle piece icon in the top right of your toolbar and connect to the Zotero Connector. This is depicted in Figure 5.

Figure 5. The Zotero Connector

![START logo]

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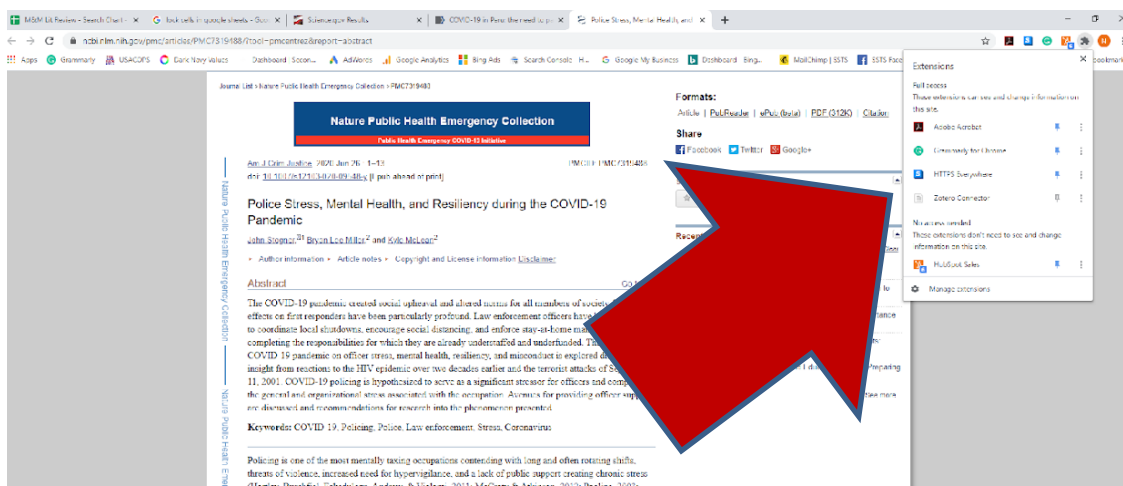
2. Then ensure the source is saving to the proper folder location. This is depicted in Figure 6. A folder will be set up for you before you start collection.

Figure 6. Individual Source Save in Zotero
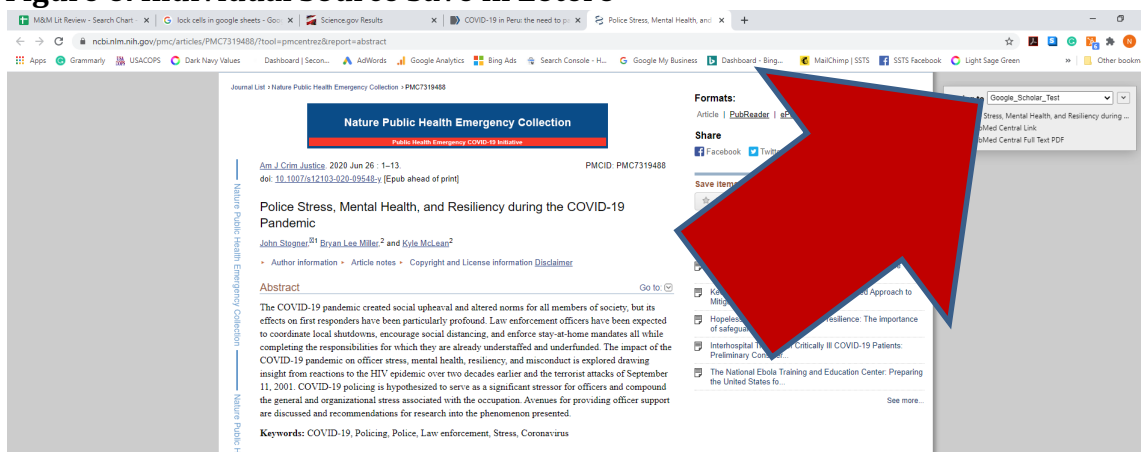
The article will then be saved to Zotero. You can confirm saving by going to the folder and checking to see that it has been saved. This confirmation is not necessary for all sources, but the occasional check may be useful.

Exporting Multiple Sources to Zotero Concurrently

Google Scholar and some of the other engines allow multiple sources to be exported to Zotero concurrently. This is a simple process.

1. After your search, connect to the Zotero plugin as you do with the single export. If you see a pop-up box open as depicted in Figure 7, you can select multiple articles for downloading.

Figure 7. Selecting Multiple Articles
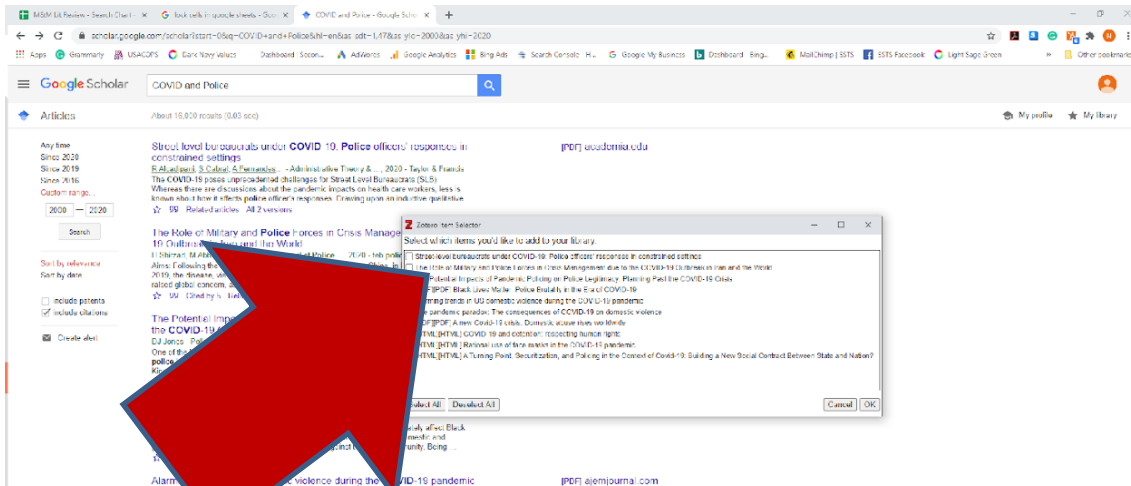
Select the articles you want to save and press "Ok". A second pop-up box with downloading information will open, just ensure it is saving to the correct folder. This is depicted in Figure 8.
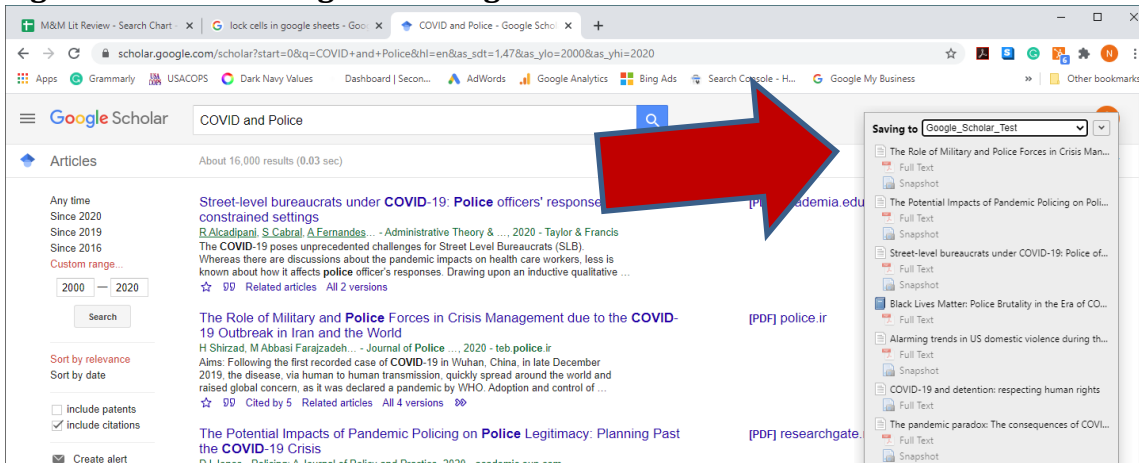
Figure 8. Downloading and Saving to the Correct Folder

The articles are then saved to Zotero. You can confirm they saved by going to the folder in Zotero and checking that the sources are present in the folder. This confirmation is not necessary for all sources, but the occasional check may be useful.

Topic Focus Orientation

Even with a pre-established set of search terms, decisions about whether or not to include a specific article involve some level of human discretion. The focus of this literature review is on how the COVID-19 pandemic affects first responders (police, fire, EMS), primarily in the United States. This includes direct effects, such as the number of firefighters who become infected with the virus and can no longer do their jobs, as well as indirect effects such as crime rates increasing due to fewer police on patrol as a result of redirected resources or understaffed departments.

The table below can be used as a quick guide to characterize the focus of this project. It is designed to help clarify what content areas will be included versus excluded from our search. Please take this as a general rule of thumb guide. We recognize that not all decisions are clear cut and the complexity of each individual study will be evaluated on its own merits. The actual searches will be the result of pre-established search terms.

Prototypical "Saves" (Green)

1. Study measuring absenteeism and quarantines of EMTS during C19.

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2. Study measuring changes in response time by police during C19.
3. Studies measuring increases in crime after a hurricane.
4. Studies describing EMT exposures to SARS during an outbreak.

Table 2. Topic Focus Guide

Green	Yellow	Red
Save	**Can Save Based on Discretion, But Not a Focus**	**Do Not Save**
Research on how the Covid19 pandemic is affecting first responders (police/fire/EMS) and/or their ability to do their job	Workplace transmission of Covid19 among first responder groups	Bio/epidemiological research on how Sars-Cov2 is spread (unless directly tied to police/fire/EMS; COVID19 symptomology) or disease treatment in general
Research on how long/short wave events are impacting demand – crime rates and law enforcement, - transports and EMS especially if directly tied to COVID or a similar long/short wave events listed in search terms	Covid19 as a bioterrorism weapon or related to terrorism.	Work on jails or prisoners, if not directly tied to police/fire/EMS. Healthcare workers operating inside a hospital. Disaster response workers who are not emergency responders.
Research on first responders or first responder groups/systems and their relation to Covid or covid-like scenarios	Research on alternative first responder groups not defined under the bins of police/fire/EMS (for example, some mental health crisis responders can straddle the line, emergency rooms, certain paramedical units that feel on the fringe, some social work organizations)	Research on the opioid crisis, or on healthcare workers (e.g., nurses)

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Research on any country. We especially like work on the United States and on FVEY states: Australia, Canada, New Zealand, the United Kingdom.		Don't ignore any study just because of country of focus. We will filter later
Research on how long/short wave events are impacting personnel (psychological stress of pandemic on EMTs)	Some studies will measure an impact upon a demand that MAY be related to a service delivered by a first responder group. 1. pandemic impacting mental health impacting resulting in more mental health calls. 2. Increases in domestic violence due to pandemic (which would potentially increase demand for services). 3. Cybercrime, which is unlikely to call on first responders in the way violent crime does.	PPE that is not particular to protecting first responders from illness on the job.
Interventions that measure or help (protect, delivery services, etc.) first responders during a long/short wave event.	*Guidance papers- any policies, best practice guides, or procedural documents on what to do, best practices, provisions, how departments recommend others respond.* Ethics papers or position papers that have no data aren't needed	Emergency Departments but make no explicit mention of EMTs or Transport.

*Note that guidance will be key to a later section of the M&M Project

Pre-Search Requirements

Prior to conducting searches, you must have the following systems set up on your computer. Please contact Alex Garinther if any of the following is not set up.
1. Zotero should be downloaded and installed on your computer and the Zotero Connector plug installed in your web browser. We recommend you use Chrome as your browser for collection.
2. Connect Zotero on your desktop to the online library set up for the project.
    a. Please note to minimize copying errors between desktop and the online Library, all collection should occur in the online Library.
3. Ensure you have write permission to the search spreadsheet available here (click here to open).
    a. If you do not have write permissions, please contact one of the project leads for authorization.

Stage 1: Collection

This section of the Codebook describes the collection process for each search engine (e.g., Google Scholar, Pubmed). Search engines will be preassigned. Please contact one of the project team leads (Nathan Meehan or Alex Garinther) for assignments.
Notes to Supervisor:
    1. Before assignment for Stage 1, ensure the group folder has been created in the Zotero Library; and

2. Ensure the coder is provided the correct Google Sheets spreadsheet.
3. After a search engine is reviewed, do a quick check of the following:
    a. Confirm publications saved source folder in Zotero
    b. Check spreadsheet to ensure that it is filled out.
    c. Confer with Coder if you see any issues.

Phase 1: Setting up Your Search

In this section of the Codebook, we will cover setting up your search.
1. Go to the relevant search engine assigned to you.
2. Open your Zotero Library
    a. The Zotero connector will not function unless Zotero is open.
3. Open up the M&M Literature Review spreadsheet (click here to open). Go to the correct folder assigned to your search engine. Complete the following initial fields:
    a. **Name:** Enter First and Last;
    b. **Date:** Enter the date of your search (MM/DD/YYYY format);
    c. **Time:** Enter the approximate start time of your search in military time (HH:MM); and
    d. **Saving to Zotero File:** Enter the name of the folder in the online Group Library
        i. Confirm you are working in the online library, not your desktop.
4. Identify the search approach for that engine:
    a. Isolated keyterm (e.g., the primary search term is entered in one location, secondary is in another);
    b. Combined keyterm (e.g., primary and secondary search terms are entered in the same location;
    c. Differentiation between scholarly and non-scholarly; and
    d. Date selection capability.
5. Set up the search parameters to match your requirements:
    a. Dates: 2000 – 2020;
    b. Article type: Scholarly, Research;
    c. If possible, set the search parameters to focus on title and abstract, NOT full text (full text can yield too many results);
    d. Ensure results will be provided for both Abstracts and full text; and
    e. Ensure sorting of results is done by relevancy.
6. Check to see if multiple sources can be exported at the same time or whether export must be done individually.
    a. Try the keywords search "Police and COVID"
    b. If the source reveals multiple results, but the pop up for selection does not open when you toggle the Zotero connector (see Figure 4), then references must be exported individually.
        i. Do not "save results" to Zotero, review, and export each article individually.
        ii. "Saved Results" will not populate the article information into Zotero.
    c. **Volume Exporting Possible**: Record determination of volume exporting as a Yes/No in the spreadsheet.
7. Record any relevant notes regarding the search approach for that particular engine.
    a. Enter in **Notes.**
    b. Remember that these search engines may yield a wide variety of results (full text, research, patents, media.

At this point, you should be ready to begin your search and collection. Please continue to Phase 2.

Phase 2: Search and Collection

In your search, you are looking for literature that is COVID-related. Specifically, this is research related to the impact of long and short-wave events on first responder organizations.

- **COVID & FRG Related:** Involves a specified long or short-wave event and an impact on a first responder (police, fire, EMS)

- **Research:** It is considered research (not news or social media, an opinion piece, law review, book review, etc.). Research includes methodologies of descriptive studies, experimental design, quasi-experimental design, qualitative interviews, observational or descriptive reports.

- **Publication:** It is a publication in an academic journal (peer or non-peer-reviewed) or a publication from a government or non-governmental research organization.

- **Effect-Related:** It describes a direct, indirect, or environmental effect of COVID-19 or an intervention to protect first responders or organizational service delivery.

As you start your search, cut and paste each search term into the search box. Please note the search terms are write-protected. A warning will appear if you try to edit the search terms.

While searching, please copy and paste the full key terms. The * (asterisks) and "quotes" are purposeful to allow more efficient searching.

After initiating the search, when looking at results, focus on the following.

- When you have identified a relevant source, export to Zotero and confirm it is saved into the correct Library.
- Review results until results are no longer relevant (perhaps go one or more page of results). Stopping is at your discretion.
- Err on the side of inclusion, a more in-depth determination will be made in the secondary inclusion check.
- Try and avoid collecting duplicates, but do not expend any real effort to exclude them. They will also be addressed in the secondary inclusion check.
- If you are not able to get full text quickly, don't worry about it. Those that pass secondary Inclusion will be tracked down.
- After completing a search term, toggle the "complete" box and move to the next.

Please take a moment and look at Figure 9. Figure 9 depicts the search setup for each keyterm. Depending on the search engine, you may copy/paste the terms separately or in combination. After you have completed a search and exported relevant sources, you can toggle the keyterm as complete.

Figure 5. Search Keyterm Setup

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	"First Responder*"	Combined Search Term	Complete
10			
11	and COVID*	"First Responder*" and COVID*	☑
12	and Pathogen	"First Responder*" and Pathogen	☑
13	and Contagio*	"First Responder*" and Contagio*	☑
14	and Virus	"First Responder*" and Virus	☐
15	and Viral	"First Responder*" and Viral	☐
16	and Epidemic	"First Responder*" and Epidemic	☐
17	and Pandemic	"First Responder*" and Pandemic	☐
18	and Infectious Disease	"First Responder*" and Infectious Disease	☐
19	and Coronavirus	"First Responder*" and Coronavirus	☐
20	and Flu	"First Responder*" and Flu	☐
21	and Influenza	"First Responder*" and Influenza	☐
22	and Hurricane Katrina	"First Responder*" and Hurricane Katrina	☐
23	and HIV*	"First Responder*" and HIV*	☐
24	and MERS	"First Responder*" and MERS	☐
25	and SARS	"First Responder*" and SARS	☐
26	and EBOLA	"First Responder*" and EBOLA	☐
27	and Hurricane*	"First Responder*" and Hurricane*	☐
28	and Tornadoes	"First Responder*" and Tornadoes	☐
29	and Blizzards	"First Responder*" and Blizzards	☐
30	and Health Crisis	"First Responder*" and Health Crisis	☐
31	and Disease	"First Responder*" and Disease	☐
32	and Personal Protective	"First Responder*" and Personal Protective E	☐
33	and PPE	"First Responder*" and PPE	☐
34			
35	"Emergency Responder	Combined Search Term	Complete
36	and COVID*	"Emergency Responder*" and COVID*	☐

+ ≡ | 🟪 Form Responses 1 ▾ | Overview ▾ | **Google Scholar** ▾

If you need to pause your search, we recommend that you complete the primary search term and record a start/stop date and time below that term. Taking a break is 100 percent ok, there are a lot of search terms!

Pausing and Completing Your Search

At the end of the search of that source, complete the following
1. **Date Ended:** MM/DD/YYYY Format
2. **Time Ended:** HH/MM
3. **Notes:** Any peculiarities about the search of this search engine.
4. **Total Number of Sources Collected:** Check the sources in the Zotero Folder and include a rough count of the sources collected.
5. **Estimated Collection Time:** In hours, the approximate amount of time you took to complete.
6. After you have completed that search engine, send an email to Alex Garinther and let him know you completed your search.

<div align="center">

YOU ARE DONE! NICE WORK!

Stage 2: Secondary Inclusion Check
</div>

The purpose of the Secondary Inclusion Check is to serve as a vetting process to decide if a specific piece of the collected literature should be included for further review in Stage 3. Also, this process will eliminate duplicate documents. There are four phases to the Secondary Inclusion Check.

The Secondary Inclusion check is performed on a single folder collected during Stage 1. You will be assigned a folder to review.

Notes to Supervisor:
1. Before assignment for Stage 2, create a copy of each folder as a backup.
2. Before assignment create a backup copy of the entire Google Sheet.
3. After the coder performs an inclusion check, conduct a review of inclusion/exclusion.
   a. Recode as you deem relevant
   b. Identify if there are any systematic changes required to the coding protocol

c. Identify if there are any deficiencies in the Coders review and follow-up accordingly.

Phase 1: Initial Documentation

The Stage 2 Secondary Inclusion is documented in the same google spreadsheet as the collection. A folder will be assigned to you by one of the team leads. When you start the folder, you will need to ensure the following

1. Your Zotero library is open to the correct group folder.
    a. Please ensure you are working in the online/group folder, not your desktop
2. Complete the Secondary Inclusion Documentation in the Google Sheets as seen in Figure 10:
    a. **Name:** Your Name
    b. **Start Date:** MM/DD/YYYY
    c. **Start Time:** HH:MM
    d. **Folder Name:** Name of folder you are working in.

Figure 10: Secondary Inclusion Notes

Phase 2. Remove Duplicates

Removal of duplicates inside of the folder must be done manually. Note that Zotero has automated de-duplication features, but these will go across all collected sources across multiple folders.

1. Sort the folder by Title (ascending) by right-clicking on the title.
2. Manually review for duplicates.
    a. If you see a duplicate title, with the same authors remove the duplicate from the file.
    b. When removing duplicates, try and keep the one with the actual document. You can remove a duplicate by right-clicking on the item and "Removing Item from Collection." This is depicted in Figure 11.
3. After removing all identified duplicates, proceed to the individual review of each source.
4. If you are not sure, do not delete it.

Figure 11. Remove Duplicates

![START](START logo)

National Consortium for the Study of Terrorism and Responses to Terrorism
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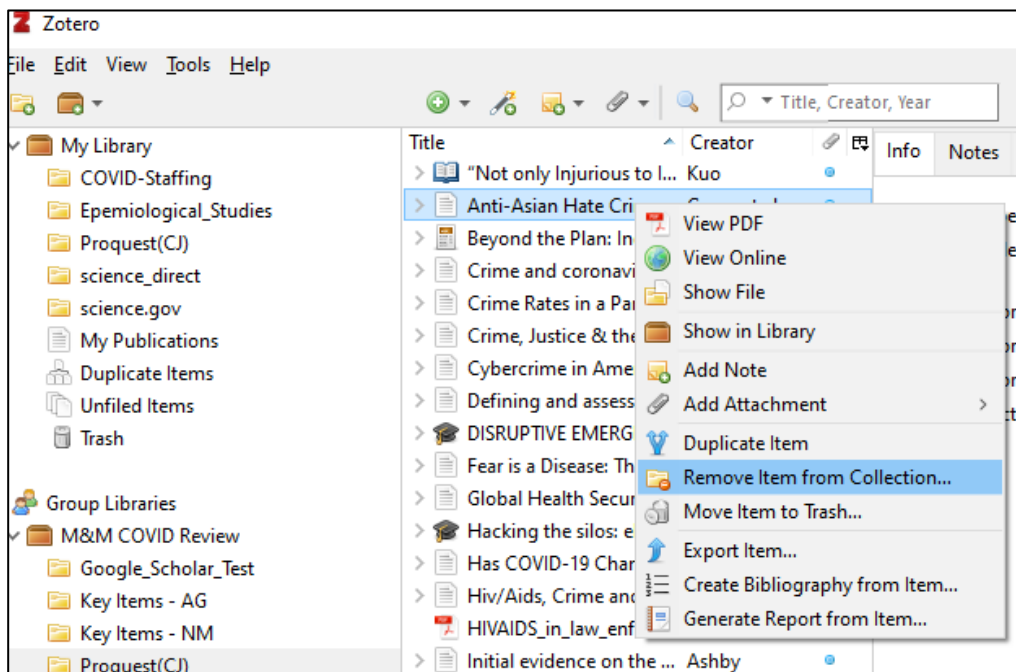
Phase 3: Individual Source Review

The second step is to review each source, and both ensure the appropriate metadata is included and make a decision to include or exclude the document for Stage 3. These criteria are articulated below.

- **COVID & FRG Related:** Involves a long or short-wave event and an impact on a first responder (police, fire, EMS)

- **Research:** It is considered research (not news or social media, an opinion piece, law review, book review, etc.). Research includes methodologies of descriptive studies, experimental design, quasi-experimental design, qualitative interviews, observational or descriptive reports.

- **Publication:** It is a publication in an academic journal (peer or non-peer-reviewed) or a publication from a government or non-governmental research organization.

- **Effect-Related:** It describes a direct, indirect, or environmental effect of COVID-19 or an intervention to protect first responders or organizational service delivery.

Your process is outlined below:

1. Open the source (in full-text pdf or the Zotero metadata)
2. Read through the abstract and title.
3. If you make a determination to include:
   a. Tag the document with "include."
      i. Tag the document via the "Tag" page on the article "Dashboard" at the top.
      ii. Do not use the other tagging features; those tend not to save.
   b. Make a note in the "Notes" field as to why it was included.
      i. With more obvious sources, you can state something like "included due to face value relevance."
4. If you make a determination to exclude:
   a. Tag the document with "exclude."
      i. Tag the document via the "Tag" page on the article "Dashboard" at the top.

      ii. Do not use the other tagging features; those tend not to save.

  b. Make a note in the "Notes" field to explain why you excluded it.

      i. Please provide enough detail in your justification to exclude that an external review can understand your rationale.

5. If based on your review, the document includes or is focused on providing "Guidance" to first responders on how to do their job,

  a. Guidance documents are those that provide insight directly to first responders how to do their job.

  b. Tag the document as "Guidance."

      i. Tag the document via the "Tag" page on the article "Dashboard" at the top.

      ii. Do not use the other tagging features; those tend not to save.

6. If based on your review, the document is of high relevance to the project, and you believe it should be marked with special attention by the project team, please tag as special.

  a. Tag the document as "Special."

      i. Tag the document via the "Tag" page on the article "Dashboard" at the top.

      ii. Do not use the other tagging features; those tend not to save.

7. If based on your review a document should be included, is the study US-focused or relates directly to the US?

  a. If directly focused on US or directly involves the US in some way

      i. Tag with "US"

  b. If references another country and it is NOT the US

      i. Tag with NOT-US

  c. If no country is reference in abstract at all or you cannot determine

      i. Tag with US

  d. This tag is most important for documents to be included or guidance.

8. If the document is tagged as include or guidance, ensure the document metadata is included for the following sections

  a. Title

  b. Authors

  c. Abstract (cut and paste from original sources, cleaning is not necessary).

  d. Publication

  e. Volume

  f. Issue

  g. Year

9. Complete the same process for each source.

Here are some important items to take into consideration when deciding to include or exclude.

1. Focus on first responders only (police, fire, EMS)

  a. Public health workers are not considered first responders

  b. Emergency services workers (e.g., red cross or federal personnel that show up later to a disaster) are not considered first responders.

  c. Emergency departments in a healthcare setting (e.g., doctors at the ER) are not included; EMTs are.

      i. EMTs are focused on transport and going to an emergency. Our work ends at the hospital doors.

   d. Military are not included.
   e. Studies that "could" apply to first responders, but do not directly focus on them should be excluded.
   f. Include articles that involve occupational exposure of first responders to infection, diseases, and viruses during the course of their duties (e.g. exposure to HIV/Hepatitis on the job), but not general health (e.g. obesity among fire fighters).
2. Studies from any country can be included.
3. Our focus is on research (and all of its forms).
4. Err on the side of Inclusion.
5. If source is a maybe, please include and make a document in the notes that you are unsure of whether the source should be included.
6. A document can be tagged with special, guidance, and include, but should not be both include and exclude.
   a. Most documents will have US/non-US and a single tag.

Phase 4: Document Completion

After reviewing all sources, go back to the google doc spreadsheet related to this folder and complete the following:

1. Total Number of Sources in Folder
2. **Tagged Include:** Total Number you tagged Included
3. **Tagged Exclude:** Total Number you tagged excluded.
4. **Tagged Guidance:** Total Number you tagged as guidance.
5. **Tagged Special:** Total Number you tagged as special
6. Double check to ensure that you have included explanations for all inclusion/exclusions.
   a. Remember, you can quickly see this as depicted in Figure 2
10. **Date Ended**
11. **Time Ended**
12. **Notes:** Include any relevant notes to your search.
13. Email Alex **Garinther** to note your completion.

Stage 3: Categorization

https://tinyurl.com/yxekl6vk.

In this stage we will categorize each document based on various features, such as study type (observational, quasi-experimental design), first responder group (police, fire, EMS), and effect type (direct, indirect, environmental). The categorization process will allow us to examine the research collected in stages 1 and 2 with a bird's-eye view, which will ultimately help us characterize the research landscape, identify gaps, and communicate our findings in concrete terms

Phase 1: Preparing to Categorize

Coders (i.e., you) will start by pulling up a Zotero Library that has passed the secondary inclusion check. Once we reach stage 3, a folder will be assigned to you with your name in the title so that you know which documents are your responsibility. In one window on your computer you will open this Zotero library, and in another window open the following LINK in your web browser (also provided above).

Qualtrics Survey & Data Capture. The URL above will take you to the data entry page (a Qualtrics survey), where the categorization will take place. We will use this survey to categorize each piece of research. Please complete all questions in the Qualtrics survey for each piece of research (estimated time per document is 4-5 minutes). Once you are done answering all questions for a given document, hit submit, and the page will refresh so that you can begin entering information on the next document in your Zotero library.

Training. Everyone will train on a practice set of documents before beginning on their official assignments. In the Zotero group library titled "M&M COVID Training", there are two subfolders marked for "Training Phase 3 - Set 1" and "Set 2". Set one contains 6 documents and set two contains 12 documents. Please complete the categorization process for both sets as you would if this were the real deal (by clicking through the Qualtrics survey, referring to the codebook as needed for clarification, reading the Abstract or Executive Summary and occasionally digging into the full-text of each document. We will review everyone's codes for these 18 documents in the training sets and make sure that all coders are on the same page before continuing with official assignments.

Phase 2: Making Categorizations

The process of making categorizations will be guided by the Qualtrics survey as described above. Answer each question in the survey and add extra detail to open-ended boxes when appropriate (extra text entry boxes will appear next to some questions). Use the table below as a guide to making your selections (it provides a little more detail behind the entry fields you will see in the survey). If you are unsure of which response to make at any given time, check back here with Table 2, or make a note of it and email Alex Garinther with your question. We have worked to minimize subjectivity and to make the process as easy as possible - please email Alex Garinther with any issues or feedback.

Organization. Stay organized as you go in order to track your progress. Start at the top of your assigned folder and work your way down. For example, if the folder "Alex - Web of Science" has 50 items in it after the secondary inclusion check from Stage 2, you will begin by opening that folder, and will complete the Qualtrics survey 50 times before this folder is considered done/coded. Please tag each document with the word "done" once it has been categorized in the survey (the last page will remind you to do this just in case).

Workflow. Ideally, you could complete an entire folder in one sitting or in a few big chunks. If you must stop half-way through a folder, mark your place carefully so that you can pick up where you left off. At this stage, we wouldn't want coders to categorize the same item twice (a waste of time and would result in duplicates). If you encounter duplicate items in the folder that made it through Stage 2, please follow the process described above to remove that duplicate from the library before proceeding with categorization. As you will see in the categorization survey, we will ask you to tag each document not only with the word "done," but also with a few other tags at this stage (e.g., police/fire/EMS).

Making Changes. Note that the survey will not proceed unless every question has been addressed, therefore you cannot skip questions. You can go back and change an answer before submitting the survey, but *once you hit submit for a given document, there is no way to edit your responses.* If you realize an error was made for a document you already coded, the best thing to do is to complete another entry for that document, and make a note at the very end of the survey (in the 'Misc. notes or comments" section) that this is a second, corrected entry.

Definitions and Overview of Categories. Throughout this categorization process there are a few definitions that will be important to know. For example, variables and values (values are possible measurements or levels along a particular variable). For instance, if *effect type is* our variable, then *environmental, direct, and indirect* effects would be considered three different values of that variable. The table in the Appendix outlines all variables that you will fill out for a given document.

Phase 3: Final Check and Review of Document Tags

Once you have completed all assigned categorizations, double check that all of your documents are "done" and have the appropriate tags at this stage in the process. Do this by clicking through all documents in your assigned subfolder. Did you miss anything? (i.e., Are all the "Included" categorized and labeled "done")? Do we need to clean up any tags based on capitalization? Is all metadata correct and complete? Did someone miss a tag earlier in the process, for either "US" vs. "Not-US", or for "police/fire/EMS"? Do the effect type tags appear to match the effect type entries you categorized in the survey?

This point in time should serve as a final sweep of all potential issues related to previous lit review steps, Zotero organization, and tagging. While the final survey question will remind you to check all appropriate tags while categorizing, consider the end of stage 3 another opportunity to check over all documents under your assignment to make sure there are no bugs, issues, oversights, etc. Below is a table of all tags that should be made at this point. Note: tags should be made in ALL CAPS.

Table 2. Zotero Tags, Stages 2-3

Tag Concept	*Possible Tags*		
Inclusion in Final Report	INCLUDE	EXCLUDE	
Country Focus	US	NOT-US	
First Responder Group	POLICE	FIRE	EMS
Effect Type	DIRECT	INDIRECT	ENVIRO
Guidance. Denotes relevance to best practices and procedural guides.	Guidance		
Special. Denotes special relevance to our project and may warrant closer review.	Special		

*Autotags. Note that Zotero applies some tags automatically when it pulls each document from the web. These (orange auto tags) can be separated from our (blue) original project tags.

Table 1A: Categorization Scheme

Variable	Variable Entry Type	Values	Descriptions
Block 1 – Basic Questions			
Coder	**Discrete (one choice)**	Names	Identify yourself.
APA Citation	**Text**	NA	To do this in Zotero, right-click on the document and select "Create Bibliography from Item." Choose APA style (7th edition) and copy that to clipboard. Then paste in the entry box.
Year Published	**Numeric**	Year in four digits	
Publication Type	**Discrete (one choice)**	Peer-Reviewed Scholarly Journal	This work was published in a peer-reviewed scholarly journal, such as *Criminal Justice and Behavior, Justice Quarterly, British Journal of Criminology*
		Practitioner or Trade Journal	A journal where the material focuses on reaching other practitioners, or those engaged in the field. These sources are to convey information-–including research, theory, and models–to those who will use them on a daily basis. The authors of this material tend to be specialists who are often engaged themselves in the daily practice. The publication might have citations, may have a few references at the end, but is generally written in an easy-to-read format and language. The articles tend to be shorter, and may have minimal or less complex peer-review.
		Government Report	A memo, white paper, government publication.
		Research from a Research Center or Institute or NGO	Many research centers or Institutes (like START at UMD) will self-publish reports or findings. This category is for such documents.

		Self-published	Self-published (includes a Dissertation, thesis, or other non-peer reviewed, non-organizational work)
		Other	
Responder Group	**Discrete (Select all that apply)**	Police	Is focused on organizations or individuals that provide a police service.
		Fire	Is focused on organizations or individuals that provide a fire department service (responding to fires)
		EMS	Is focused on organizations or individuals that provide an emergency medical service. Paramedics.
		Other	enter
		None	This study is not explicitly tied to any first responder group.
Country	**Discrete (one choice)**	US (plus text)	US is country or region of focus of the study. If study is of a specific state or city, add detail if possible
		Non-US Five Eyes Nation	Focus is not US but is a country within the Five Eyes Alliance. (Australia, Canada, New Zealand, the United Kingdom) Plus Text
		Outside of Five Eyes (plus text)	These we may remove
		International	Focus is on multiple countries

<table>
<tr><td colspan="4" align="center">Block 2 – Details

<i>*Note - italicized variables in this block denote a branch in the survey flow. These variables will only appear if your selections from earlier in the survey prompt them (e.g., if you select "Natural Disaster" as an Event Type, the survey will branch to ask you if it was a hurricane, tornado, or fire.</i></td></tr>
<tr><td rowspan="2">Data. Did the researchers collect their own</td><td rowspan="2">Discrete / Check All that apply</td><td>No data</td><td></td></tr>
<tr><td>Collected new data</td><td>Original research, created own data</td></tr>
</table>

data or use someone else's?		Analyzed existing data	From someone else, an agency database, mined from records, etc.)
Data Type. Which of the following best describes the data seen here?	**Discrete (one choice)**	Qualitative	
		Quantitative	
		Qualitative and Quantitative	
Study Type. **Which of the following best describes the design / approach of this research?**	**Discrete / one choice**	Theoretical conceptualization (no data collected)	Basically, an author simply saying "here is how I am thinking about this" or "a framework for approaching the study of" or "ideas for research on"… but there is no data collected, no study design.
		In-depth interviews or focus groups	A small-N study that used semi-structured interviews, focus groups, to collect qualitative in-depth data with a few participants
		Analyzing results of a large-scale poll or survey	A large survey distributed to many participants to gain a high-level view, not as in-depth as a small-N interview, more broad scale.
		Analysis involving agency data/records (non-survey).	For example, emergency calls on 911 line. Number of dispatches during a time frame. Number of complaints recorded during April.
		Literature review or meta-analysis	Literature review or meta-analysis
		Other	Text (describe)

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Evaluation	**Yes/No**		Was an evaluation performed to assess either the process of some program or the impact of some program?
Evaluation Type	**Discrete (Check all that apply)**	Process	Process Evaluation – looks at how something was implemented (a program, policy, intervention, procedure).
		Impact	Impact Evaluation – assesses the outcomes associated with some program, policy, intervention, procedure.
Evaluation Name	**Text**	NA	Enter the name of the program evaluated and provide some short description.
Eval 1st or 3rd Person	**Discrete (Check all that apply)**	Evaluated own	The authors of this report also launched the program being evaluated
		Evaluated someone else's program	
		Other (enter)	
Intervention	**Yes/no**		Was an intervention involved in this study?
Intervention Type	**Discrete (Check all that apply)**	Yes, Environmental Yes, Direct Yes, Indirect Yes, Other No	We manipulated X to see its effect on Y. Yes, study focused on an intervention focused on demand/environmental effects
Intervention Type Intervention Description.	**Discrete (Check all that apply) Text**		Study focused on an intervention related to protecting individual personnel.
			Study of on an intervention related to an indirect effect (basically anything that was not indirect or environmental
			Study's intervention cannot be categorized into the above (explain why)

			Study did not involve an intervention
		NA	Description of intervention. Use 2-3 sentences. Spend a maximum of 2 minutes.
Intervention Effect Type	**Discrete (Check all that apply)**	Environmental Direct Indirect	You said this work contained an intervention. At what level did the intervention operate? Select all that apply.
Intervention Evaluated?	**Yes/No**		Did the researchers evaluate the intervention? (assess its effects?)
Event Type	**Discrete / Select all that apply**	COVID19	COVID specifically
Event Type *Natural Disaster detail*	**Discrete / Select all that apply Discrete / choose one**	Natural disaster	Includes blizzards, tornadoes, hurricanes
		Infectious disease	Includes Ebola, HIV/AIDS, SARS, MERS
		General injury	General Injury to first responders was assessed, covered multiple / more than the categories seen here (e.g., stabbings, concussions, and infection etc.)
		Other (Text)	Other type of event (e.g., Bioterrorism).
		Blizzard, Tornado, Hurricane, Fire, Other	Check the box that describes the event type in more detail
Infectious disease detail	**Discrete / choose one**	Ebola, HIV/AIDS, SARS, MERS, Flu, Other	Check the box that describes the event type in more detail
Event Name (only if natural disaster or other	**Text**	NA	Text description of event (e.g., Hurricane Katrina)

selected for event type)			
Unit of Analysis	**Discrete / Select all that apply**	Individuals	Unit of Analysis is people (e.g. police officers, or EMTs)
Unit of Analysis Major Findings	**Discrete / Select all that apply Text**	Organizations, Departments or Jurisdictions	Unit of Analysis is organizations (e.g. police departments or fire departments.
		States, Regions, or Countries	
		Multi-level	Unit of Analysis multi-level (e.g. EMTs within multiple/different organizations).
		Events or Incidents	A study that correlated an increase in 911 calls during a tornado would be "Events / Incidents"
		Other	
		NA	Description of major findings. Use findings mentioned in the Abstract. If that's not possible, use findings that are mentioned prominently at the start of the discussion section, or in the conclusion – but don't dive too much deeper than that.
Effect Type	**Discrete / Select all that apply**	Environmental	Related to an external demand for service. For example, an EMS provider with 10 ambulances and 50 personnel are seeing a 30 percent increase in medical transports each week.
Effect Type Topic Focus	**Discrete / Select all that apply Discrete (Check all that apply)**	Direct	Related to the direct impact of an event on agency personnel (e.g. infected or injured persons due to an event). For example, per week, approximately two more personnel are testing positive for COVID-19 and quarantined (a direct effect).
		Indirect	An impact inside an organization, is not direct or environmental. For example, personnel being quarantined is resulting in a 45 percent increase in

			response time due to fewer ambulances and available crews (an indirect effect).
		Staffing	Related to the availability of personnel. Includes absenteeism related to quarantines, reduction in staff etc.
Topic Focus Relevance	**Discrete (Check all that apply) Discrete (one choice)**	Deployment	Related to how available personnel are tasked (shifts/geography, etc.)
		Demand (includes Crime Rates)	Related to how much or the type of service the organization is asked to provide. This includes crime rates.
		Availability of PPE	Related to the availability of PPE to personnel.
		Use of PPE	Related to the use of PPE by personnel.
		Service Delivery	Related to how the organization provides services or responds to requests for service.
		Policy	Related to directives on how an organization propose to respond/deliver services
		Human Resources	Related to the management of personnel within organization
		Financial Costs	Related to financial costs
		Communication	Related to how an organization communicates with its personnel or public about its activities.
		Training	Related to how the organization trains it personnel (all topics, not just topic at hand).
		Technology	Related to technology responders use
		Testing	Related to testing for particular disease/exposure
		Productivity	Related to quantity of services an organization is able to provide with available personnel.
		Public Reaction	Related to how the public views the activities of the organization

		Mental Health / Well-being	A study of the mental health and/or well-being of first responders surrounding an event
		Physical health	A study of the physical health of first responders surrounding an event
		Enforcement or Compliance with public health mandates	Study involves ability to comply with, or enforce, public health mandates (e.g. wearing masks, keeping distance among persons, etc.) among first responders or public
		Transportation	Focus on how people move
		Occupational Exposure	Exposure to harm (typically in the form of infectious disease) on the job
		Preparedness	Distinct from training, preparedness covers a broader sense of readiness for action during crisis
		Other (Text)	
Relevance	**Discrete (one choice)**	5 Stars – Very strong	Reviewer believes this research has very strong relevance to the overall Project
		4 Stars – Strong	Reviewer believes this research has strong relevance to the overall Project
		3 Stars - Medium	Reviewer believes has moderate relevancy to the overall Project
		2 Stars – low	Reviewer believes has low relevance to the overall Project.
		1 Star – very low	Reviewer believes has very low relevance to the overall Project. Any documents that are rated with this 1-star rating will be re-evaluated for inclusion.

Appendix B: Categorization "Survey"

1. Who is submitting?

- ○ Alex

- ○ Nate

- ○ Maria

- ○ Kerry

- ○ Montserrat

- ○ Other _____

2. Which Zotero (sub)folder are you coding from?
- ○ Google Scholar
- ○ Web of Science
- ○ Science.Gov
- ○ ProQuest
- ○ PubMed
- ○ ScienceDirect
- ○ NCJRS
- ○ Other _____

3. **Submit the bibliography entry for document.**
Copy from Zotero - right-click, APA 7th Edition, bibliography, copy to clipboard.
If the metadata seems incorrect or incomplete still - please look into and fix. Enter with no spaces before or after if possible.

_____

_____

_____

3b. **Enter year published:**

_____

4. **What is the Publication Type?**
In other words, where was this research published?
NOTE: almost all will be peer-reviewed scholarly.

Examples of Peer-Reviewed Scholarly Journals:
American Journal of Criminal Justice
International Journal of Emergency Mental Health and Human Resilience
Occupational and Environmental Medicine
Academic Emergency Medicine
JAMA Network Open
Journal of Offender Rehabilitation
Criminology & Criminal justice

Examples of Practitioner Journals (rare):
FBI Law Enforcement Bulletin
NIJ Journal
Government Reports:
Bureau of Justice Statistics Reports
National Institute of Corrections Library Uniform Crime Reports
UN Annual Report of Programming
NGO / Research Institute Publication (rare):
Getty Research Report on Crime 2019-2020
Pew Research Center Survey of Attitudes Toward COVID-Driven Lockdowns

- ○ Peer-Reviewed Scholarly Journal
- ○ Practitioner or Trade Journal
- ○ Government Publication (e.g., Uniform Crime Reports)
- ○ Work from a Research Center, Institute or NGO (e.g., Getty Research Center Annual Report)
- ○ Self-published (includes Dissertation, thesis, or other non-peer reviewed, non-organizational work)
- ○ Other _____

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5. **On which first responder group(s) is this work focused?**
Select all that apply.

☐ Police

☐ Fire

☐ EMS

☐ Other (enter below) _____

☐ None. This is not explicitly tied to any first responder group.

6. **What is the country of focus?**
USE TEXT ENTRY TO ADD DETAIL IN THE SPACE PROVIDED
If US, and focused on a particular region, enter the name of that state (use two letter abbreviation – e.g., NY, CA, IL).   If it is a Five Eyes Nation, enter the name of that country (type out full country name – e.g., Australia)

◯ US _____

◯ Five Eyes Nation (Australia, Canada, New Zealand, the United Kingdom) _____

◯ Outside Five Eyes Nation _____

◯ International/Multinational

7. **Did the researchers collect their own data or use someone else's?**

☐ No data in this piece

☐ Collected new data

☐ Analyzed existing data (from someone else, an agency database, mined from records, etc. - if you can easily name the source, there is a box below to do so - ex. NYPD Call Center Database) _____

7a. **Which of the following best describes the data seen here?**
◯ Qualitative data

◯ Quantitative data

◯ Both Qual and Quant data

○ None of these

8. Which of the following best describes the design / approach of this research?
  You may only select one.

○ Theoretical conceptualization or "position paper" (does not involve data)

○ Literature review or meta-analysis

○ Analyzing results of a survey, or large-scale poll

○ Analysis involving agency data/records (not a survey).

○ In-depth interviews or focus groups

○ Other _____

9. Was an evaluation performed in this piece of research?
 Did they look at how or how well a program worked?

Definition: An evaluation is the process by which investigators determine how well a program/policy/procedure is meeting desired outcomes.

There are two main types: process and impact.

 Process Evaluation – looks at *how* something was implemented (a program, policy, intervention, procedure).
ex: "Understanding the New Cardiac Arrest Response System Protocols for Paramedics in Dallas, TX"

Impact Evaluation – assesses the *outcomes* associated with some program, policy, intervention, procedure.

ex: "Understanding the effects of a double patrol-car policing policy on the rate of petty crime stops in New Jersey"

○ Yes, process

○ Yes, impact

○ Yes, both process and impact

○ No

○ I don't know / other _____

9a. **You said an evaluation was conducted. Did the authors of the document launch the program that was evaluated, or did they evaluate someone else's program?**

☐ Evaluated their own program

☐ Evaluated someone else's program

☐ Other _____

9b. **Enter the name of the program evaluated and then provide a very short (1-2 sentence) description.**

Ex: COVID Readiness Training for Suffolk County PD. This document evaluated COVID readiness training that took place from March 15-April 1 among police in Suffolk county. The training covered PPE guidance, new patrol routes, and procedures for dealing with ticketing to minimize contact with individuals.

_____

_____

_____

_____

10. **Was there any kind of <u>intervention</u> involved in this piece of research?**
Did they try to change something?

 The intervention does not have to be the focus of the work, but if an intervention of any kind was present or discussed in this document, select "yes" below.

 (an "intervention" includes: a new policy, field studies of a policy implementation, a program that was

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implemented to prevent infection, quasi-experimental comparisons of different state's approaches to COVID policy, experimental manipulations or tests, RCTs or randomized controlled trials,)

○ Yes, Intervention present

○ No, there was no intervention

○ I don't know

10a. Did the researchers evaluate the intervention? (i.e., did they assess its effects? measure its outcomes?)

○ Yes, they did

○ No

○ I don't know

10b. In 1-3 sentences, write a description of the intervention.

Cut and paste from abstract if possible. Spend a maximum of 2 minutes describing this.

EX: A new policy of the Chicago Police Department asked officers to patrol neighborhoods using two vehicles instead of one so that officers could remain socially distant during COVID19. While before two police officers would ride together in one vehicle, now each had their own vehicle. Researchers examined impact this had on stops, overall crime rates, and budgetary concerns for the dept.

_____

_____

_____

10c. You said this work contained an intervention. At what level did the intervention operate?

Select all that apply.

Definitions (for the event of COVID19):
Environmental Effects: Changes in level and type of demand for services due to an event (e.g. the pandemic). These are unrelated to infected personnel and may impact the quantity and type of service organizations are asked to deliver.

Direct Effects: Illness-driven absenteeism, reduced productivity, and mortality of personnel.

Indirect Effects: The effects of COVID-19 on operations and ability to provide services due to a combination of direct and environmental effects.

For example, an EMS provider with 10 ambulances and 50 personnel are seeing a 30 percent increase in

medical transports (an environmental effect) each week. Per week, approximately two more personnel are testing positive for COVID-19 and quarantined (a direct effect). The reduced number of personnel is resulting in a 45 percent increase in response time due to fewer ambulances and available crews (an indirect effect).

☐ Yes, Environmental

☐ Yes, Direct

☐ Yes, Indirect

☐ Yes, Other _____

☐ I may have been mistaken

11. **Which of the following best describes the event studied?**

○ COVID-19

○ Natural Disaster (blizzards, tornadoes, hurricanes)

○ Infectious disease (Ebola, HIV/AIDS, SARS, MERS)

○ General Injury

○ Other _____

11a. **Which type of natural disaster?**

○ Blizzard

○ Tornado

○ Hurricane

○ Fire

○ Other_____

11b. **What was the name of the infectious disease?**

○ Ebola

○ HIV/AIDS

○ SARS

○ MERS

○ Flu (Influenza)

○ Other _____

11c. **Type the name of the event below (e.g. Hurricane Katrina, 9/11).**

_____

12. **In this work, the <u>Unit of Analysis</u> was:**

For example, a study that surveyed the mental health of individual firefighters for PTSD following a hurricane would be "individuals"

A study that compared police responses in NYPD to Chicago PD during COVID19 would be "Jurisdictions"

A study that correlated an increase in 911 calls during a tornado would be "Events / Incidents"

If a study looks at police within organizations using a more complicated design that examines how these factors interact, that might warrant a selection of "Multi-Level"

- ○ Individuals

- ○ Events or Incidents (ex. crime reports, 911 calls)

- ○ Organizations, Departments, or Jurisdictions

- ○ States, Regions, or Countries

- ○ Multi-Level

- ○ Other _____

13. **Would you describe this as a book-length piece with multiple potentially relevant findings that are hard to capture in this survey?**

- ○ Yes

- ○ No

- ○ I don't know

14. **In 1-3 sentences, describe the main findings of this work.**

Copy and paste from the Abstract or Executive Summary when possible.

Please do not spend any more than 1 or 2 minutes on this entry.

_____

_____

_____

15. **Which of the following best describes the effects being studied?**
(You may select multiple)

Definitions (for the event of COVID19, as an example):
Environmental Effects: Changes in level and type of demand for services due to the event (e.g., the pandemic, the hurricane, the outbreak). These are unrelated to infected personnel and may impact the quantity and type of service organizations are asked to deliver.

Direct Effects: Illness-driven absenteeism, reduced productivity, and mortality of personnel (in the example of COVID).

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 Indirect Effects: The effects of COVID-19 on operations and ability to provide services due to a combination of direct and environmental effects.

 For example, an EMS provider with 10 ambulances and 50 personnel are seeing a 30 percent increase in medical transports (an environmental effect) each week. Per week, approximately two more personnel are testing positive for COVID-19 and quarantined (a direct effect). The reduced number of personnel is resulting in a 45 percent increase in response time due to fewer ambulances and available crews (an indirect effect).

☐ Direct effects

☐ Indirect effects

☐ Environmental effects

☐ Other / None (use sparingly - feel free to explain) _____

16. **Which of the following topics did this study focus on?**
Select all that apply from the list of ~20 below.

 Sort your responses into primary topics (the most clear) and secondary topics.

There are two columns below.

For the column PRIMARY/MAJOR topics, select the 1 or 2 (or occasionally 3) topics that BEST fit this piece of research.
For SECONDARY/MINOR column, select any additional topic areas not selected as primary, but that still have some relevance to the project.
Primary topics are the obvious ones (1-3), and secondary topics are more of a stretch (any additional).
You cannot re-select/duplicate any topics as both primary and secondary

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	Primary (Major) Topic Focus	**Secondary (Minor) Topic Focus**
Staffing	☐	☐
Deployment	☐	☐
Demand (includes crime rates)	☐	☐
Availability of PPE	☐	☐
Use of PPE	☐	☐
Service Delivery	☐	☐
Policy	☐	☐
Human Resources	☐	☐
Financial Costs	☐	☐
Communication	☐	☐
Training	☐	☐
Technology	☐	☐

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Testing (for disease)

Productivity	☐	☐
Public Reaction	☐	☐
Mental Health / Wellbeing of First Responders	☐	☐
Physical Health of First Responders	☐	☐
Enforcement or Compliance with Public Health Mandates	☐	☐
Transportation	☐	☐
Occupational Exposure	☐	☐
Preparedness	☐	☐
Other	☐	☐

- -

17. **Rate the relevance of the document to the overall project on this 1-5 scale.**

A very relevant document (e.g. "Coronavirus cases among NYC police, and subsequent effects on staffing" would receive 5 stars.

Note that documents that receive a 1-star rating will be re-evaluated for their inclusion in our project.
Rate: ☆   ☆   ☆   ☆   ☆

18. **Did you remember to make the appropriate tags in Zotero?**

Please make these tags in <u>ALL CAPS.</u>

<u>Tags to Make at This Stage</u>
    Group (can be multiple): POLICE, FIRE, EMS
    Effect Type (can be multiple): DIRECT, INDIRECT, ENVIRO
    Completion: DONE

* The tag "DONE" indicates the document has been categorized using this survey. This will help us track

which documents have been completed.

EXAMPLES:
The document "Has COVID-19 Changed Crime? Crime Rates in the United States during the Pandemic" should be tagged with "police", "environmental", and "done" (when complete).

The document "SARS Outbreak 2003: The Response of the Toronto Police Service" should be tagged with "police", "direct", "indirect", "environmental", and "done" (when complete).

Tags That Should Have Been Entered Previously
(You Can Make Them If Needed Now)   **Country** (US, NOT-US)   **Inclusion** (Include, exclude)*
        Guidance   Special
*All documents that reach this stage should by definition have an "include" tag

Make sure everything looks correct before submitting.

○ Yes, I have entered all the appropriate tags for this file in Zotero, including "DONE"

○ No, I haven't entered "DONE" because more attention is needed on this file.

- -

19. **Use this space for other comments or notes about this document. If no special notes are needed, feel free to leave this space blank.**

_____

_____

_____

_____