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Fire Service COVID-19 Infection Prevention and Control Policy Comparison

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By

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To date, there have been over 2.7 million deaths and more than 126 million cases attributed to the COVID-19 pandemic (JHU, 2021). This pandemic has affected nearly every aspect of daily life. Among those impacted are U.S. firefighters, as they provide many services beyond simply extinguishing structure fires and are frequently dual certified as emergency medical technicians. Many of the victims of this pandemic have relied on first responders to provide them with emergency medical care and hospital transport. When caring for these infected patients, firefighters have an increased risk of exposure and must be provided with adequate resources and guidance on how to best protect themselves. To assess the COVID-19 pandemic plans utilized by U.S. fire departments, this study performed a qualitative review of COVID-19 pandemic plans from metropolitan fire departments across the nation. The fire department policies were compared to the 117 recommendations established by national and international authorities on COVID-19. Analysis of the fire department COVID-19 plans revealed 29 recommendations that were followed by all agencies reviewed, 72 recommendations that were intermittently acknowledged, and 16 recommendations that were included in no fire departments plans. The study also identified unique practices in the COVID-19 infection prevention and control plans reviewed.

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LIST OF ABBREVIATIONS

APIC	Association for Professionals in Infection Control and Epidemiology
BSI	Body Substance Isolation
COVID-19	Novel Coronavirus Disease 2019
CDC	Center for Disease Control and Prevention
EMT	Emergency Medical Technician
EMS	Emergency Medical Service
ESS	Emergency Services Sector
FICEMS	Federal Interagency Committee on Ems
FF	Firefighter
FF-EMT	Firefighter-Emergency Medical Technician
HQ	Headquarters
HCW	Health Care Worker
IAP	Incident Action Plan
IPC	Infection Prevention and Control
LODD	Line of Duty Death
MRSA	Methicillin-Resistant Staphylococcus Aureus
NEMSSC	National Ems Safety Council
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
OG	Operational Guidelines
PHSM	Public Health and Social Measures
PSAP	Public Safety Answering Points
PUI	Person Under Investigation of Infection
PPE	Personal Protective Equipment
SARS-COV-2	Severe Acute Respiratory Syndrome Coronavirus 2
SOP	Standard Operating Procedure
HRWG	The Federal Healthcare Resilience Working Group
TB	Tuberculosis
TRACIE	Technical Resources, Assistance Center, and Information Exchange
U.S.	United States
WHO	World Health Organization

CHAPTER 1: INTRODUCTION

Background

Firefighters (FFs) in the United States (U.S.) respond to all requests for assistance whenever a hazard is present or may potentially develop. Fire agencies refer to this obligation as an all-hazards response approach, striving to save lives and mitigate the dangers associated with fires, Haz-Mat events, motor vehicle accidents, medical emergencies, specialized rescues, and any other incident where harm to life or damage to property may occur. Roughly 65% of fire department emergency responses in the U.S. are to care for people who are in medical distress (NFPA, 2019). In recognition of medical call volumes, many fire departments employ FFs who are cross-trained as Emergency Medical Technicians (EMTs). These firefighter-emergency medical technicians (FF-EMTs) receive training on the proper treatment of patients suffering from a wide variety of medical emergencies. Medical emergencies frequently present situations where emergency responders come into contact with infectious body substances. To minimize the infectious exposures in the U.S., all organizations employing health care workers (HCWs) are federally mandated to implement training and education for their personnel on bloodborne pathogens, respiratory protection, and personal protective equipment (OSHA, 2011, 2012, 2016)). Many organizations choose to implement Infection Prevention and Control (IPC) programs, which are a holistic approach to infection prevention.

Fire departments educate and train their emergency response personnel on the appropriate levels of Personal Protective Equipment (PPE) and Body Substance Isolation (BSI) procedures for the diverse variety of emergency calls that they will respond to. Each fire department must develop its own unique IPC program and ensure that they can provide their personnel with the necessary PPE for every emergency that they may encounter. What level of PPE should first responders don when facing a novel infectious disease with unknown transmission characteristics? What BSI policies do fire departments enact amid worldwide PPE shortages? The current COVID-19 pandemic has forced many fire departments in the U.S. to reanalyze the efficacy of the infectious disease policies that they have instituted. This thesis will compare pandemic IPC policies from multiple metropolitan area fire departments across the country with the recommendations set forth by numerous agencies, including the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) to identify crucial IPC elements and to shed light upon standard IPC components needing improvement. There is currently a significant deficit in available research for this important and relevant issue.

Pandemics

According to the WHO, when a novel disease is discovered that spreads across multiple countries and affects large numbers of people with no apparent immunity, it is under their authority and obligation to issue a global pandemic declaration (LOC, 2020)(WHO, 2010). The classical term "pandemic" has been argued to relate to a disease's geographic spread and not the effect that it has on people (Kelly, 2011). The current

COVID-19 pandemic, however, has had a significant effect on humanity, surpassing 126 million identified cases and causing greater than 2.7 million deaths worldwide (JHU, 2021a). The WHO is cautious about its responsibility in declaring global pandemics. In his work, Madhav et al. discusses how pandemics can have substantial noteworthy societal ramifications, often disrupting national economies, impacting the health of a population, and can also cause significant amounts of public panic (Madhav et al., 2017). Following the declaration of a pandemic, specific control measures are implemented globally in an attempt to stop or minimize the spread of the disease, the WHO refers to these as Public Health and Social Measures (PHSM). PHSMs include disease surveillance and response measures (contact tracing, isolation, and quarantine orders), personal protective measures (encouraging frequent hand washing and public face mask requirements), environmental measures (increased general cleaning, implementing improved ventilation systems, and disinfection), physical distancing measures (domestic travel restrictions, stay at home orders, and social distancing requirements), and also encouraging the implementation of international travel restrictions (WHO, 2020b).

The most devastating pandemic to have occurred in the 20th century was the 1918 H1N1 influenza. Although the origins of this pandemic are still unclear, the first documented case occurred in January 1918, in Haskell County, Kansas, and was caused by a strain of the H1N1 virus, which DNA sequencing has revealed to be most similar to an avian species virus (Barry, 2004). It is estimated that the 1918 H1N1 influenza infected approximately 500 million people (roughly 1/3 of the world's population at the time), caused 50 million fatalities, and lowered the life expectancy in the U.S. by over 12 years

(Jordan, 2019). In the years following the 1918 H1N1 pandemic, many advancements have been made in the field of medical sciences, including the introduction of vaccinations, antivirals, and antibiotics, the ability to diagnose and study influenza viruses, the establishment of intensive care units with mechanical ventilation, and also the development of plans relating to pandemics and infection control (Jester et al., 2018). Even with all the scientific advancements that have been made since 1918, humans are still incredibly vulnerable to influenza viruses. Many reasons contribute to this influenza vulnerability; among them is the exponential population growth that has occurred since 1918. Population growth has increased population density in many regions throughout the world, which closely correlates to disease propagation (Li et al., 2018). This population growth has increased the necessity for food supplies, correlating to increased swine and poultry populations. The swine and poultry species have both been recognized as notable intermediaries for zoonotic diseases (Gray & Kayali, 2009). Strong evidence suggests that the expansion of modern farming practices into previously isolated wildlife habitats, combined with the increase in human interactions with livestock, correlates to the increased incidence and intensification of emerging diseases (Jones et al., 2013).

The most recent of our past pandemics to occur was the 2009 H1N1pdm09 pandemic. The first laboratory-confirmed case of the 2009 pandemic was observed in Mexico in February, and from there, the virus rapidly spread around the world (Fineberg, 2014). The CDC estimates that the 2009 pandemic caused 115,700 – 575,000 global fatalities (CDC, 2019). This virus was very unusual in that 80% of the attributed deaths occurred in populations younger than 65 years of age. During a typical flu season, 70-90% of the

mortalities occur in populations 65 years of age and over. The fact that the 2009 pandemic had a more significant effect on younger populations caused some scientific communities to speculate that the older population had likely been exposed to an earlier circulating H1N1 virus, developing ostensible immunities to this new H1N1 variant (Morens et al., 2010).

On December 31, 2019, the WHO received notification concerning a cluster of atypical pneumonia cases in China's Wuhan Peninsula. In 3 months, the number of infected escalated to over 118,000 cases in more than 110 countries. On March 11, 2020, the WHO made the declaration that the novel Coronavirus Disease 2019 (COVID-19) had reached pandemic levels (WHO, 2020a). The viral load necessary for conversion from exposure to infection is still unknown, but COVID-19 is transmitted with relative ease via person-to-person airborne droplets and has an incubation period of approximately 2-14 days (Dhama et al., 2020). COVID-19 is caused by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). Common symptoms experienced with COVID-19 infections include fever or chills, cough, shortness of breath or difficulty breathing, fatigue, muscle or body aches, headache, the new loss of taste or smell, sore throat, congestion or runny nose, nausea or vomiting, and diarrhea (CDC, 2020a). The rapidity in which COVID-19 has spread may be due in part to the fact that asymptomatic transmission has been observed in 59% of cases (Johansson et al., 2021). SARS-CoV-2 has been found to have a case fatality rate of 2.3% (Wu & McGoogan, 2020). Infected individuals should be considered contagious 2-3 days before the initiation of symptoms (He et al., 2020). The CDC reports that those with mild to moderate COVID-19 symptoms have been found to

remain infectious for up to 10 days after the onset of symptoms, and individuals who are critically ill can remain infectious for up to 20 days after symptoms begin (CDC, October 19, 2020). Significant comorbidities that have been associated with severe COVID-19 infections include old age, hypertension, diabetes, cardiovascular disease, cerebrovascular disease, chronic obstructive pulmonary disorders, renal disease, and past cancer diagnoses (Fang et al., 2020).

Fire Departments and Pandemics

FF-EMTs encounter a wide variety of patients in very dynamic environments, often facing weather extremes, poor lighting, and many other unpredictable hazards. When working in these uncontrolled environments, Emergency Medical Services (EMS) providers face considerably elevated risks of exposure to infectious diseases (Leiss et al., 2006). In an attempt to mitigate as many of the controllable hazards as possible, fire departments generally develop Operational Guidelines (OGs) and Standard Operating Procedures (SOPs). These SOPs and OGs have become the standard of practice in the fire service and serve as guidance for emergency personnel on the correct courses of action to take when specific situations present themselves (Warren, 2016). Many fire departments develop numerous volumes of detailed SOPs and OGs for common incidents encountered (i.e., structure fires, EMS responses). However, they may lack robust SOPs/OGs for uncommon events, such as pandemics. The Occupational Safety and Health Administration (OSHA) mandates that employers with HCWs implement programs to protect their personnel against bloodborne pathogens and previously identified respiratory infections such as tuberculosis (TB), Methicillin-resistant Staphylococcus

aureus (MRSA), and Influenza; however, current federal regulations do not specifically address policies on emerging infectious diseases transmitted through other routes (OSHA, 2020b). The minimally available data to date imply that the U.S.' current EMS system is ill-prepared to respond to a severe pandemic, with specific deficiencies identified in industry-wide decontamination practices, infection control practices, pandemic preparedness frameworks, and EMS providers' willingness to respond to infectious disease. In his work, Ventura et al. discovered an absence of national disinfection standards regarding EMS equipment, finding that disinfection practices were guided solely by specific EMS agency standards or local protocols (Ventura et al., 2020). Ventura et al. found that the disinfection of stethoscopes between patient contact was not a regular practice. In a different study, Nunez et al. determined stethoscopes to be ideal fomites, harboring various pathogens, but they were readily cleaned with isopropyl alcohol (Nunez et al., 2000).

The recent observed worldwide PPE shortages have caused countless disruptions to the entire healthcare industry, but these shortfalls have been uniquely profound to EMS providers working in uncontrolled prehospital environments. The 2011 National EMS Assessment indicated significant deficits in the national pandemic framework, with specific insufficiencies identified with federal, state, and local integration plans; decontamination capabilities; continuity of operations plans; mass casualty transportation resources; and PPE supply caches (Mears, 2011).

FF's respond emergently to hazardous situations while assessing the potential risks and following well-developed and coordinated protocols. Firefighters will enter a

burning building to extinguish the fire and save the lives of others but will only do so with the appropriate complement of PPE, capable of withstanding extremely high temperatures and providing them with breathable air. FF-EMTs responding to medical emergencies do so with this same mindset; making assessments of the potential dangers, donning the proscribed PPE compliments, and will only then proceed appropriately. When FF-EMTs lack the appropriate protocols or PPE compliments, there is real potential that they may decide the risks of response are too significant. In a study conducted by Barnett et al., paramedics were asked about their willingness to respond to infectious disease patients when presented with a scenario in which they were provided inadequate PPE levels for an infectious disease, and with no prospective vaccine. Unsurprisingly, only 4% of the surveyed participants reported that they "probably would" stay on duty. Of the respondents presented with the previous scenario, 83% of the paramedics indicated that they "would definitely not" or "probably not" remain on duty. When the same group of paramedics were queried on their willingness to remain on duty if provided with adequate PPE and also provided with a vaccine for the disease, 91% of the participants indicated that they "probably" or "definitely" would remain on duty (Barnett et al., 2010). U.S. EMS providers are paramount to our nation's health, especially so during a national disaster such as a pandemic. The importance of providing them with the proper IPC protocols, PPE, and available vaccination therapies cannot be understated. Many paramedics in the above study indicated that their primary fears were related not to themselves becoming infected but the risk that they could potentially infect their family members (Alwidyan et al., 2020).

Health care workers rely on PPE as a last line of defense. PPE serves to protect HCWs when all other administrative, engineering, and work practice controls are unable to protect them from potentially infectious exposures. The worldwide PPE shortages experienced during the COVID-19 pandemic effectively took this last line of defense away. In a survey of 23,000 U.S. nurses, 87% of the respondents reported having to reuse single-use disposable N95 respirators. Of those, 27% stated that they had been exposed to confirmed COVID-19 patients without utilizing the proper levels of PPE (United, 2020). A similar survey consisting of EMTs in the U.S. discovered that only 48% of the respondents reported having access to the proper N95 masks when needed. Of those, 31% reported having to reuse disposable (single-use) for one week or greater. Additionally, 16% of the EMT participants from the survey reported that they suffered injuries due to excessive PPE wear (Ventura, 2020). The consequences related to the overuse of PPE can include skin injuries and a noted decrease in the efficacy of PPE for both source and exposure control.

Statement of the Problem

Throughout the COVID-19 pandemic, EMS personnel have worked tirelessly on the front lines, with insufficient PPE, fighting an invisible enemy, all while following frequently guideline changes. OSHA defines FF-EMTs as professionals who are at "very high exposure risk" to the COVID-19 virus (OSHA, 2020a). The significance of this exposure risk was revealed when COVID-19 was found to be the leading cause of FF line of duty deaths (LODD) in the U.S. for the year 2020 (USFA, 2020b). EMS providers play

a pivotal role in the healthcare system, initiating lifesaving first aid to critically injured patients.

In a recent survey involving nearly 4000 professionals employed in the public service sector (Police, FFs, EMTs, Paramedics, and Corrections Officers), the results suggested that FF's were the least likely respondents to wear face masks (Friese, Jul 31, 2020). Given the novelty of the COVID-19 virus and the lack of available scientific evidence regarding its transmission characteristics, FF-EMTs must adamantly practice the procedures that we know to be effective in stopping the spread of this virus. One of the most significant components of COVID-19 IPC is the widespread use of facemasks. The fact that FFs are the emergency service professionals who have been found to be the least likely group to wear face masks, coupled with the fact that COVID-19 was a significant cause of FF LODDs in 2020, is a clear indicator that there are significant IPC deficits in the fire service. During COVID-19, several fire departments across the U.S. have been deficient in formalized pandemic SOPs, communicating pandemic guidelines to their personnel via departmental memos. The nature in which these memos have been delivered and recorded has made them difficult to reference.

Critically ill COVID-19 patients are found to possess higher viral loads, correlating to the shedding of higher viral particulates inside their poorly ventilated homes (To et al., 2020). FF-EMTs generally make contact with these particular patients inside of their contaminated residences, as these patients are frequently too ill to ambulate outside. During these interactions, it is paramount for emergency responders to practice good BSI procedures while utilizing the necessary PPE. Personnel who respond to these events

must also practice the appropriate decontamination procedures when doffing their PPE. Firefighting is an inherently dangerous occupation, and the current pandemic has only increased this profession's associated hazards.

Project Significance

The National Fire Protection Association (NFPA) reports that there are roughly 1,115,000 FFs, associated with over 29,705 fire departments, who respond to 36,746,500 emergency calls in the US every year (Evarts, 2020). Firefighters provide the communities in which they work with many essential services. The COVID-19 pandemic has exposed numerous pandemic IPC vulnerabilities within this critical infrastructure sector. This thesis aims to identify the necessary components required for a successful pandemic IPC plan and to characterize common pandemic IPC policy strengths and insufficiencies. This thesis intends to serve as a reference tool for fire departments when developing or revising pandemic related protocols.

CHAPTER 2: LITERATURE REVIEW

PPE Shortages

During the COVID-19 pandemic, significant deficits were observed in the essential PPE caches for the HCW population (SHEA, 2019). Possessing adequate levels of the necessary PPE during an infectious disease outbreak is a crucial non-pharmaceutical component to the successful disease containment within a population (Lemon, 2007). When HCWs treat infected patients without the appropriate levels of PPE or effective IPC policies in place, the likelihood that they will become infected increases. HCWs who

become infected will no longer be able to perform their job duties, frequently facing lengthy isolation/quarantine periods, and can often contribute to the further taxing of an already burdened health care system. HCWs represent between 2-3% of a communities population; however, they make up 14% of the COVID-19 infections (WHO, 2020c). When utilizing improper PPE, HCWs inadvertently generate conditions in which they may serve as vectors for disease transmission. Previous works have shed light on the numerous cases where HCWs have unknowingly transmitted disease to their own patients (Huttunen & Syrjänen, 2014). By wearing appropriate levels of PPE and following well-developed IPC plans, HCWs can better protect themselves and the patients for whom they are providing care. Due to the recent worldwide PPE shortages, many fire departments and emergency response agencies in the U.S. have been forced to supplement the use of N95 masks with commercial-grade elastomeric respirators. These masks have proven to be an effective means of protecting the individuals wearing them from COVID-19; however, these types of masks frequently lack filtered exhalation valves, allowing any infected mask wearer to disperse viral particulates into the environment (Chang et al., 2020). When considering that 59% of the COVID-19 cases in one study were transmitted from asymptomatic carriers, there is a high likelihood that infected wearers of unfiltered masks could serve as vectors for COVID-19 transmission (Johansson et al., 2021). No peer-reviewed studies have been conducted at this time to illustrate the risks of COVID-19 transmission and particulate masks with unfiltered exhalation valves.

Thousands of firefighters have been infected, and hundreds have been killed from COVID-19. FF-EMT personnel have a significantly higher risk of COVID-19 infections

than the general population (Leiss et al., 2006; OSHA, 2020a; USFA, 2020b). One factor that has been associated with the elevated risk of COVID-19 infections in the FF-EMT population has been the shortages of essential PPE and disinfectant supplies (Terri Rebmann et al., 2020). The insufficient caches of disaster supplies and PPE is a vulnerability that has existed for decades, having been identified in multiple previously conducted national EMS assessments (FICEMS, 2009; Mears, 2011). The cause of this PPE shortage has been attributed to multiple complex issues, ranging from explosive consumer demand, limited agency budgets, government planning, and preparedness failures, to disruptions in the global supply chain (Cohen & Rodgers, 2020). This thesis will not seek to resolve this widespread PPE shortage issue; however, it may provide potential recognized options for the appropriate disinfection and reuse of this vital PPE.

Important Pandemic IPC Elements

When facing a pandemic, preparation is a tremendous key to success. Success is vital when considering that failure equates to the potential loss of human life and preventable casualties. The EMS Infectious Disease Playbook lays out a roadmap for agencies to develop pandemic IPC programs (EMS Infectious Disease Playbook 2017). Among the many reliable resources available to fire departments when developing and implementing IPC programs, the Association for Professionals in Infection Control and Epidemiology (APIC) has been recognized as a national authority on the best-of-practice in infection control (NEMSSC, 2017). The APIC has developed tools for fire departments to utilize when creating tailored IPC programs for their institutions. The APIC reports that the six major components to a successful IPC program are administrative controls,

engineering controls, work practice controls, education, medical management, and the establishment of immunization programs (Woodside, 2013). The APIC recommended infection control program components are detailed in Table 1, below.

Administrative Controls - Surveillance Programs - Up-To-Date Infection Control Policies and Procedures - Exposure Control Plans - Referenceable and Dynamic Policies - Routine Hazard Risk Assessments	**Engineering Controls** - Adequate PPE Caches - Decontamination Facilities - Appropriate Cleaning/Disinfecting Agents - Necessary Safety Equipment
Work Practice Controls - Frequent Hand Washing - Standard Precautions – PPE - Employee Screening - Proper Decon Practices - Disposal of Contaminated PPE - Environmental Decontamination - Facility Social Distancing Practices	**Education** - Initial and Recurrent Infection Control Practices - Current and Emerging Infectious Threats - Frequent & Routine Policy Review
Medical Management - PSAP Triaging - Limiting Personnel Exposure - Interacting in Well Ventilated Areas - On Scene Assessment and Distancing - EMS & Patient PPE - Exposure Prophylaxis	**Immunization Program** - Ensuring Personnel Are Immunized Against Vaccine-Preventable Diseases - Ensuring Personnel Will Receive Priority for Novel Vaccines

Table 1. APIC Infection Control Program Components

Additional resources regarding pandemic specific IPC recommendations are available from the CDC and the WHO. The CDC released a set of interim recommendations for the U.S. EMS System & Public Safety Answering Points (PSAP) after

the COVID-19 pandemic was declared. One of the fundamental principles stressed in this document was the promotion of improved coordination and communication between PSAPs, EMS agencies, and hospitals (CDC, 2020c). The dissemination and sharing of accurate information is an incredibly important function during pandemic declarations (HHS, 2021). The increased use of social media platforms by those who view them as reliable news outlets poses serious potential implications (Pennycook et al., 2020). Fire Departments should only utilize accurate information provided by trusted and verified resources when developing policies for their personnel. During an infectious disease outbreak or pandemic, emergency response agencies should coordinate closely with their PSAP to develop and institute a set of modified caller queries to screen patients early for potential signs and symptoms of infection. PSAP 911 dispatchers should relay pertinent patient information to responding crews and instruct the patient to don a facemask before emergency crews arrive, if available (CDC, 2020c; EMS Infectious Disease Playbook 2017).

Surveillance

This thesis's focus will not regard public health surveillance systems; however, it should be stated that these programs must be well functioning so that emerging infectious disease outbreaks are identified early, and the appropriate policies are implemented before the inadvertent exposure of personnel occurs. When departmental surveillance programs fail to recognize potential infectious threats, events similar to what happened in Kirkland, Washington can occur. In late February 2020, 31 FF-EMTs were unknowingly exposed to COVID-19 after responding to a nursing home where several patients

ultimately died from COVID-19 (Malcolm, 2020). After reviewing the call run logs for this facility, FF-EMTs later admitted that they should have recognized this infectious outbreak event. Fire Departments should provide emergency crews with sufficient education to recognize the signs and symptoms of potential infectious outbreaks and report their observations to the appropriate agency staff members. In a survey conducted by Rebmann et al., EMS personnel who received targeted pandemic training where they were educated on and provided with adequate levels of PPE were identified to have an increased willingness to work during infectious disease outbreaks and expressed greater confidence in treating infectious patients (T. Rebmann et al., 2020). Rebmann et al. further discussed how these education curriculums should be specific and include the most current epidemiological information relating to emerging infectious diseases available.

Preparation and Prevention

The CDC recommends that before starting their shifts, fire department personnel should be screened for the signs and symptoms of potential infection, with active temperature checks being completed prior to entering crew quarters. Resources on the updated signs and symptoms of COVID-19 infections should be reviewed on the CDC website (CDC, 2020d). PPE training should include didactic and practical segments on proper donning and doffing procedures. Given that nearly 40% of the doctors and nurses in a PPE study were observed to be practicing the doffing process incorrectly, it is likely that many EMS professionals, who operate in uncontrolled prehospital environments, would have similar, if not higher, risk for improper PPE doffing (Okamoto et al., 2019). The CDC recommends that emergency response agencies should implement universal

source control measures for personnel during the entirety of their shifts, as well as implementing comprehensive social distancing policies while in station quarters and on agency apparatus (CDC, 2020c). Both of these practices will minimize the risk of person-to-person transmission and help maintain the vital adequate staffing levels. Crews should receive training on the proper disinfection techniques for the stations, equipment, and apparatus. The U.S. Fire Administration provides fire departments with disinfection resources and has created numerous volumes of industry related disinfection guides (USFA, 2020a).

Response

The CDC recommends that first responders should receive COVID-19 screening information from the PSAP 911 dispatchers while responding to emergency calls (CDC, 2020c). FF-EMTs should follow departmental policy when deciding which level of PPE to don. Many fire departments are developing progressive policies, whereby FF-EMTs are contacting 911 callers while enroute to the scene and initiating their own surveillance. These policies help responding crews get a better picture of the nature of the call and the PPE required once on scene. Due to the high rate of asymptomatic carriers, fire departments should utilize policies that will protect their personnel from inadvertent exposures of this population. Once personnel arrive to an emergency, they should perform scene surveillance, minimize crew exposure, and attempt to maintain the 6 feet social distancing recommendation (CDC, 2020c).

Contact Tracing

In coordinating with local PSAPs on the screening of COVID-19, fire departments should also establish relationships and channels of communication with area hospitals. The CDC reports that developing effective means of communication about emerging infectious diseases is important for every participant involved in community health (CDC, 2020c). EMS should provide local hospitals with early warning when they are transporting potentially infected patients so that hospital HCWs can appropriately prepare for their arrival. When hospitals determine that an infected patient was transported to their facility via EMS, they should notify that provider of the potential exposure risks encountered. This open communication during a pandemic will help protect HCWs in the hospital and prehospital settings more effectively, better protecting this vital workforce

CHAPTER 3: METHODOLOGY

Project Objective

The purpose of this thesis project is to use national and international recommendations for emergency responder IPC policies to compare and contrast plans from fire departments across the U.S. Common practices will be identified, along with missing or incomplete criteria, and recommendations will be made for improvement to plans to ensure consistency of planning across the nation.

Sample Population

IPC plans relating to the current COVID-19 pandemic were collected from large metropolitan area fire departments. The convenience sample of fire departments included in this study were selected because they represented different geographic regions across the U.S., providing essential services to diverse populations, including communities located in urban, suburban, as well as rural areas. Internet searches were performed to locate the contact information for the fire agency headquarters (HQ). Communication was made with the fire department HQs and contact information for the agency infection control officer was requested. The fire departments were contacted via telephone & email. The agencies infection control officers were contacted, explained our study's details and objectives, and requested to participate. Each agency was informed that all identifying information regarding the participating organizations IPC programs would be excluded from the final report. The documents requested from each fire department included all available documentation that they had prepared relating to COVID-19. The study received universal support from the agencies we were able to make contact with, and significant interest was expressed in the need for additional studies of this nature. Several of the agencies contacted had formal processes for public information requests through their municipalities' Human Resources Department. The formal requests for these agency documents were made, and delays were encountered due to the ongoing pandemic, as many HR departments were very short staffed. The 6 fire departments that eventually supplied the study with IPC documentation included career fire agencies from the Southeast, Midwest, and Northwest regions of the U.S. The largest fire department

included in this study has over 70 fire-rescue stations and more than 2700 employees. The smallest fire department included in the study has 16 stations and greater than 300 employees. The documents obtained from the different fire agencies were received via email and accessed from online website addresses that agency personnel provided to the study.

Data Collection Method

Pandemic IPC guidance documents were accessed and obtained from multiple recognized authorities in the fire service and public health industries. The authorities referenced were the CDC, the WHO, the U.S. Fire Administration, The International Association of Firefighters union (IAFF), the Technical Resources, Assistance Center, and Information Exchange (TRACIE), APIC, The Federal Healthcare Resilience Working Group (HRWG), and OSHA. These documents were reviewed, and specific IPC elements were identified and categorized from each. The specific identified IPC elements from the recognized authorities were recorded onto a spreadsheet and used as criteria for comparison of pandemic plan data. The assembled national and international authority IPC recommendations entered into the spreadsheet were utilized to create a master IPC template. This IPC evaluation criteria template was used to analyze and compare IPC elements from the convenience sample of fire department plans. IPC element criteria included components such as personnel screening, facility decontamination, equipment decontamination, apparatus decontamination, required PPE, PPE decontamination and reuse procedures, personnel decontamination procedures, social distancing guidelines, training protocols, contact tracing functions, mealtime accommodations, common crew

area recommendations, visitor policies, confirmed exposures, quarantine & isolation guidelines, PSAP call taker queries, on-scene patient management, and special situations.

Study Data

The documents obtained from each fire department were reviewed while cross referencing the study's IPC evaluation criteria template. Fire department IPC elements that were identified as correlating with the study's IPC evaluation criteria template were recorded on to the template's spreadsheet. This comparison evaluation identified common strengths and weaknesses in the individual fire agency pandemic plans and compared the particular programs to one another.

CHAPTER 4: RESULTS

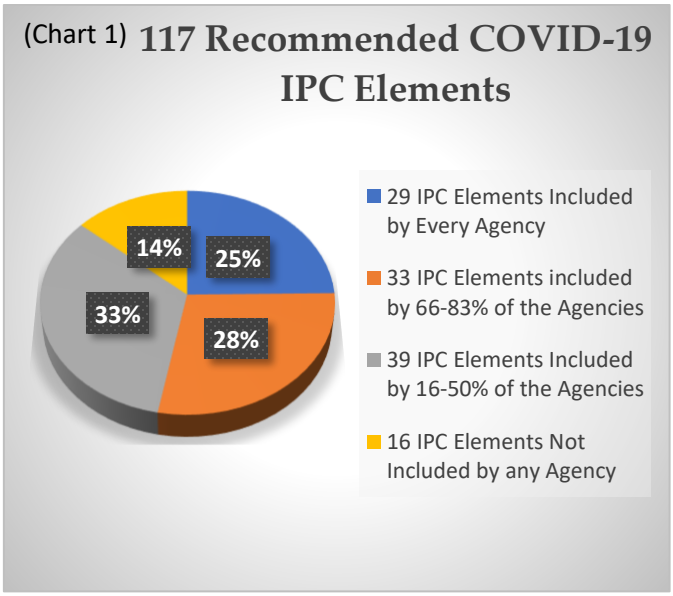
IPC Evaluation Criteria Template

The national and international COVID-19 IPC guidance elements were reviewed and organized into the following categories to serve as review criteria for the plan evaluation and comparison: public safety answering points (PSAP) modified screening questions, infectious disease training, PPE, fire department facilities, patient treatment practices, cleaning and disinfection procedures, post-exposure definitions and actions, contact tracing & documentation, continuity of operations/workforce protection, ambulance operations, and also special considerations. The studies' final IPC evaluation criteria template consisted of 12 categories that comprised 117 separate pandemic-related elements.

The study was ultimately able to collect and review over 100 COVID-19 pandemic guidance documents from six professional fire departments across the U.S. The various documents received from the participating agencies included Operational Guidelines, Chiefs Memos, Operational Memos, Standard Operating Procedures, City Press Releases, Emergency Medical Protocols, Municipal Policies, Response Procedures, Medical Services Training Memos, Statewide Ordinances, Training Pamphlets, Training Videos, Checklists, and also Just-In-Time Training documents. All of the documents above will be referred to as fire department pandemic IPC plans from this point forward, although the limitations of this are discussed later.

The information provided by each fire agency was reviewed, analyzed, and recorded into the study's IPC evaluation criteria template. Of the 117 IPC elements included in the studies IPC evaluation criteria, the agency that accounted for the most significant number of IPC elements had policies that included 77 (66%) of these in their plans. To identify these 77 IPC elements, the study authors had to review 26 separate documents from that agency. The fire agency that accounted for the least amount of the recommended elements had policies in place that covered 48 (41%) of the 117 IPC recommendations. The 48 components were identified following the review of the seven

(Chart 1) 117 Recommended COVID-19 IPC Elements



provided departmental documents. Of the 117 recommended COVID-19 IPC elements, 29 were included by every agency reviewed. 33 Of the IPC elements were included in 66-88% of the agencies reviewed. 39 Of the IPC elements were included in 16-50% agencies. 16 Of the IPC elements were unaccounted for by all agencies reviewed (chart 1).

Most Common Recommended IPC Elements

The elements of the IPC evaluation criteria template that were consistently listed by every participating fire department's COVID-19 plan are provided in Table: 2.

Table 2: COVID-19 IPC Components Accounted for by Every Fire Department Surveyed

Pandemic Plan Elements:	
All department personnel are provided copies of the pandemic documents	The plan is developed in coordination with local healthcare partners.
Personnel are provided details about the pandemic, infection prevention, and control practices.	Specific PPE criteria is detailed for the emergency call type and patient symptomology
Strategies in Place to Optimize PPE Supplies	
Personnel interactions are limited with patients	Personnel use of reusable PPE
IPC Plan Includes Appropriate Use of the Following PPE	
Eye protection	Respiratory protection
Gowns or suits	Gloves
Patient Treatment Guidelines	
PPE use is determined by reported patient symptomology and departmental guidance	Infection screening is performed on every patient
Patients and family on scene must wear face masks during every interaction	N95 or better respiratory protection is worn by personnel on all patient interactions
If patient requires O2, airway device is used in conjunction with face mask	Aerosol-generating procedures are defined and discussed
Early notification of a suspected COVID-19 patient is provided to the receiving hospital	

Cleaning and Disinfection Procedures Provided for		
Fire department facilities		EMS equipment
Fire department vehicles		Decon procedures for PPE
Establishment of approved disinfectants		Promotion of frequent hand hygiene
Post Exposure Definitions and Actions		
High-risk exposures are defined, and the following actions are taken		
14-day quarantine where individuals will self-monitor for signs and symptoms of infection	-OR-	Individuals will quarantine for 10 days and if no symptoms are observed following daily monitoring, work restrictions are concluded
Contact Tracing and Documentation		
Personnel who develop signs and symptoms of infection shall self-isolate and notify agency infection control officer		Personnel with on-the-job exposures are documented and communicated with the local health authorities to ensure accurate contact tracing is performed
Return to work policies are in place for infected personnel who have recovered		Every contact with a PUI is documented through an agency established reporting system.

IPC Components Observed in 66-88% of the Fire Departments

The elements of the IPC evaluation criteria template that were accounted for by 66-83% of the fire department COVID-19 plans reviewed are provided below (Table 3).

Table 3: IPC Elements in 66-83% of Fire Departments

Pandemic Plan Elements	
A dedicated staff position is identified in the plan and is ultimately responsible for the agency's infectious disease preparedness	
Public Safety Answering Point (PSAP) Modified Screening Questions	
The plan indicates the implementation of modified call taker screening criteria	911 call taker will ask about signs and symptoms of infection
Call takers provide responding EMS with early notification of positive infection screening	911 call taker will ask about travel history to effected regions
Infectious Disease Training	
Training includes proper PPE donning and doffing procedures	

PPE	
PPE contingencies are developed (alternative PPE components are provided and described)	Strategies are in place to optimize the current PPE supplies
Limited reuse of disposable PPE	PPE is donned in correct order according to departmental guidance
<u>PPE doffing procedure:</u> - Appropriate doffing procedures developed by agency - If personnel duty uniform under PPE is discovered to have become soiled, personnel will return to station for uniform change - Soiled uniform items will be washed at the station with proscribed disease prevention guidelines - Hand hygiene is performed	
Fire Department Facilities	
Sick personnel are directed to stay home	Personnel screening process is implemented at the beginning of each shift and detailed
Visitors are restricted from entering facilities	Mask use is required during entire shift
Social distancing is mandated while inside agency facilities	
Patient Treatment Practices	
Hand hygiene is performed before and after all patient contact	Patients should be moved outside to ventilated area
Number of personnel who contact patients is limited	Interacting with patient and family in poorly ventilated environments is avoided
Implementation of modified treat and release policies	Metered dose inhalers are supplemented instead of nebulizers
HEPA filters are used on advanced airway exhalation ports.	
Post Exposure Definitions and Actions	
Low-Risk Exposures are defined, and agency response is detailed	
Contact Tracing	
State or local public health authorities are notified of all PUI interactions	
Continuity of Operations – Workforce Protection	
Mental health counseling resources are available, and personnel are encouraged to seek assistance if the need should arise	
Ambulance Operations	

Ventilation strategies are optimized the in ambulance	Driver and patient compartments are separated
PPE guidelines are developed and in place to prevent contamination of driver compartment	

IPC Components in 16-50% of the Fire Departments

The elements of the IPC evaluation criteria template that were accounted for by 16-50% of the participating fire departments are provided in Table 4.

Table 4: IPC Components in 16-50% of the Fire Departments

Public Safety Answering Point (PSAP) Modified Screening Questions	
Known contact with infected persons	Call taker records call back phone number and relays to responding crews
Additional persons at the location with signs and symptoms of infection	
Infectious Disease Training	
All non-essential in-person training is postponed in favor of pandemic-specific virus-related training	Proper PPE Donning and Doffing procedures
Decon procedures for station, EMS equipment, PPE, & vehicles	
PPE	
PPE equipment caches are maintained, appropriate quantities can be determined using tools like those supplied by the CDC's PPE Burn Rate Calculator or equivalent	Use of filtered respirator exhalation valves is discussed (if present)
Doffing PPE: - Checklist is utilized - PPE is inspected for damage prior to doffing - PPE is doffed in designated areas	Donning PPE: - PPE is inspected to ensure it is serviceable (absent of cuts or tears, appropriate size) - Hand hygiene is performed
Use of boot covers while treating patients	
Fire Department Facilities	
Non-essential personnel work from home and are provided the resources to do so	Personnel uniform items kept at station
Hand sanitizer dispensers are readily available	Off going personnel shall shower before going home

Patient Treatment Practices	
Personnel are instructed to avoid touching their face	Only necessary equipment is brought to the patient scene to avoid unnecessary equipment contamination
Cleaning and Disinfection Procedures:	
Use of disinfectant wipes is encouraged opposed to sprays, when in enclosed compartments	Biohazard cleaners are contracted for gross station decontamination
Facility outbreak is declared if a workplace has two or more confirmed or probable infection cases within 14 days	Decontamination checklists are created and provided to crews
Post Exposure Definitions and Actions	
Personnel quarantine is discontinued after Day 7, following a diagnostic specimen negative test, with no observed symptoms during daily monitoring	
Continuity of Operations – Workforce Protection	
Nonpunitive sick-leave policies are developed for personnel with on-duty exposures	Contact is maintained with employees in quarantine and planning is made for their replacements
Vaccinations are strongly encouraged	Novel virus vaccine delivery plans are developed for the rapid vaccination of all department personnel
Telecommuting tools provided for non-essential employees and leadership positions	Non-essential department personnel are reassigned and retrained to assist in mission-essential tasks
Additional emergency response vehicles are staffed to meet patient surge needs	
Ambulance Operations:	
Additional passengers (family, etc.) shall not be transported with patient	Non-essential compartments and cabinets for patient care are sealed
PUI transfer of care process into the hospital is developed according to local guidelines, to minimize interaction with unprotected individuals	

Absent IPC Elements

Several of the recommended IPC elements were discovered to be missing from every fire department included in this study. The missing IPC elements are listed in Table 5.

Table 5: IPC Recommendations Not Included in Any Plan

IPC Elements Absent in All Agency Plans	
Pre-arrival Instructions to Family from PSAP Dispatch:	
Family shall assist in expediting EMS crew access to the patient	Family shall help prepare patient for transport
Family shall compile a list of patient medications	Family shall help patient meet the EMS crews at entry of house
Infectious Disease Training	
Training is provided to personnel on updated protocols before they are implemented	Personnel shall demonstrate any new PPE donning and doffing competencies before use
Personnel family members are provided training materials	
Patient Treatment	
PPE should be donned by personnel utilizing checklists	Personnel to perform debrief at the conclusion of transport, verifying appropriate infection control procedures were followed.
Hospital contact information is to be left with family so that they may call for patient updates.	Patient belongings are to be considered contaminated, placed in sealed and labeled biohazard bags.
All patient care documentation is to be performed after the transport is complete; no patient care documentation is to be performed in the patient compartment	
Continuity of Operations – Workforce Protection	
Development of procedures to hire back retired or previously active members to assist if personnel staffing becomes an issue	
Fire Department Facilities	
Station ventilation practices are optimized	
Special Considerations	
Pediatric patient considerations discussed	

IPC OUTLIERS

Reviewing the COVID-19 pandemic plans from different fire departments and comparing them with our IPC evaluation criteria template provided a means to systematically analyze the compliance with national and international IPC guidelines. Reviewing the IPC policies from multiple fire departments also allowed the study to

identify unique IPC components. These were unique IPC features that were not expressly contained in the IPC evaluation criteria template; however, they were implemented by agencies to help achieve their mission statement and to better protect their personnel. The table below (Table 6) provides the unique IPC practices identified when reviewing the different fire department IPC documents.

Table 6: Fire Department IPC Outlier Practices

Fire Department IPC Outliers
While en-route to emergencies involving potentially infected patients, personnel will make contact via cell phone and perform additional infection screening questions. If a potentially infected patient is able, request that they meet responders outside.
Personnel who require quarantine will be provided with quarters to do so, preventing possible exposure to their family members
All long-term care facilities are designated as "HIGH RISK" occupancies. All personnel entering are required to don full COVID-19 PPE prior to entering.
Alternative decontamination method use for vehicles after infected patients are transported (Ozone generators, disinfection foggers, UVGI machines)
Twice daily personnel temperature screening and station decon procedures
Utilization of UVGI machines to decon used N95 masks
Encouragement of personnel involvement IPC policy development
Crew mealtimes are staggered in stations with multiple companies
Online forums are established for EMS partners within regions to share consistent policies, COVID-19 training resources, and updates
Mobile device applications used to track personnel placed under quarantine
Development of patient assessment practices that minimize crew interactions with patients
Implementation of childcare programs to provide for crewmembers on shift
Expansion of mobile health services to better serve vulnerable populations

CHAPTER 5: DISCUSSION

The results of this thesis provided several valuable outcomes regarding IPC policies in the Fire Service. The studies' research and establishment of the IPC evaluation

criteria template may be utilized by Fire/EMS agencies in the development or amendment of pandemic IPC plans in the future. The IPC evaluation criteria template was fundamental in identifying distinct strengths and weaknesses among the agencies studied. Additionally, the study presented unique IPC elements that were utilized by fire departments which were not included in the recommendations by the recognized authorities.

IPC Elements Included by all Fire Departments

The 29 recommended IPC elements that every participating fire department incorporated included IPC guidance involving PPE, patient treatment, cleaning and disinfection procedures, post-exposure actions, and contact tracing programs. The utilization of appropriate levels of PPE while treating infected patients is one of the cornerstone IPC elements during an outbreak event when the engineering and administrative controls implemented are unable to prevent these interactions from taking place. When considering the nature of the emergency services and the hands-on role that FF-EMTs are frequently required to provide, close patient interactions are difficult, if not impossible, to avoid. Because COVID-19 is easily transmissible from person-to-person airborne droplets, unprotected individuals in close proximity to an infected patient are at a high risk of infection (Dhama et al., 2020). Every organization reviewed in this study was found to have appropriately implemented PPE policies requiring eye protection, gowns, gloves, and respiratory protection of N95 or better when in close proximity to a potential COVID-19 patient. All agencies were also discovered to have instituted policies attempting to limit the number of personnel who interacted with these potentially infected

individuals. When rendering treatments to the infected individuals, all departments also implemented guidelines on high-risk interventional medical procedures. Aerosol generating procedures, for example, were detailed, and alternative treatment modalities were included in every plan included in our study. This is noteworthy when considering that the performance of aerosol-generating procedures emits potentially infectious viral particulates freely into the environment, creating an increased risk of infection to anyone nearby who has not donned the proper PPE.

Every fire department reviewed should be recognized and commended for the unanimous compliance of ensuring face masks are used by everyone in attendance during all patient interactions. The IPC plans reviewed included continued source control measures even when it was necessary to administer supplemental oxygen. Several agencies included diagrams in their policies on how best to appropriately deliver oxygen with the continued use of patient face masks. Consistent use of face masks (source control) has been identified as one factor related to a decreased risk of infection (Wu et al., 2004).

IPC Elements Included by the Majority of Plans

The 33 IPC elements included in 66-83% of the fire department IPC plans contained policies to guide communication between emergency responders and the PSAP 911 dispatchers, provided strategies for optimizing PPE, screened personnel for infection, and provided guidance for ambulance operations considerations.

As the first point of patient contact on the majority of EMS runs, the PSAP 911 dispatchers have an opportunity to provide FF-EMTs with invaluable information. With minimal additional questioning, these dispatchers are able to identify the common signs

and symptoms consistent with SARS COV-2 infections and relay their suspicions to responding crews upon dispatching the call. The communications forwarded from the PSAP 911 dispatchers can provide FF-EMTs with central details regarding the patient's condition, the required level of PPE, the necessary EMS equipment to bring into the scene, and the number of personnel required to render medical aid. When details about a potentially infected patient are delivered early, the emergency responders are given the opportunity to better prepare themselves, which can lead to improved PPE compliance and enhanced patient care management.

The global PPE shortages experienced throughout the COVID-19 pandemic have raised serious supply concerns for many organizations involved in health care. Fire departments that initially reported robust PPE stockpiles quickly realized the reality of PPE consumption during this event and were forced to implement policies promoting sustainability. The development of procedures to optimize available PPE, such as establishing processes to disinfect and recycle single-use N95 masks, enabled many agencies to maintain sufficient PPE levels and continue to provide their personnel with adequate levels of protection. Several fire departments developed policies and guidelines detailing the safe reuse of specific PPE components.

FF-EMTs are typically employed on shift rotation schedules, working at least 24 hours at a specific station per shift, essentially living with their coworkers. This cohabitation amongst coworkers presents a significant vulnerability for the transmission of COVID-19. To combat this, most fire agencies surveyed implemented stringent policies in opposition to personnel reporting to work sick. To help enforce these policies, many

fire departments implemented pre-shift personnel screening processes. These processes consisted of active temperature checks and screening questions before personnel were allowed to enter the station living quarters. The study observed that some fire departments allowed members to complete these screenings on their own recognizance, while others required a company officer to perform the screenings on their subordinates. The screening process is crucial when considering that an undetected COVID-19 FF-EMT has the potential to infect an entire station.

IPC Elements Commonly Missing from Plans

The study's results indicated that 39 of the IPC recommendations were accounted for in only 16-50% of the agencies reviewed. These important IPC elements included details about PPE use, practices concerning fire station facilities, patient treatment policies, and policies focused on workforce protection.

During the COVID-19 pandemic, many fire departments distributed elastomeric respirators to their employees. These masks offer excellent respiratory protection, are reusable, and can be disinfected by personnel with minimal effort. The disadvantage to these masks is that they often lack filtered exhalation ports. Respirators with unfiltered exhalation ports allow for respiratory droplets to be exhaled freely into the environment. EMS responders wear PPE to protect themselves as well as their patients. When considering that asymptomatic transmission was observed in 59% of the COVID-19 cases in one study, the importance of utilizing filtered exhalation valves is evident (Johansson et al., 2021).

Personnel employed in the emergency services often work in uncontrolled environments, face weather extremes, and respond to emergency scenes where they are exposed to infectious substances. The above-mentioned working conditions are often present during routine operations. Risks for exposure increase in the early phases of a pandemic when the details of the novel virus transmission are limited. During a typical shift throughout the COVID-19 pandemic, FF-EMTs often encountered situations where they became inadvertently exposed to COVID-19 virus particulates. During these situations, the personnel's duty gear often became contaminated as well. To minimize the risk of exposing personnel family members to soiled uniform items, a limited number of the fire departments implemented policies requiring employees to store all uniform items at the stations and encouraged personnel to shower before going home. The simple act of showering and changing into clean clothes can have a tremendous effect on eliminating the contaminants on a person.

When an employee develops an illness and continues to report to work, they expose their coworkers to the risk of infection. This concept is especially true when employed in the emergency services industry. Firefighters essentially live at their stations for the duration of their shift, residing in close proximity with their coworkers. Many firefighters try to avoid taking sick leave because in doing so, they will have to utilize 24 hours of their paid time off bank. In recognition of the associated risks in having potentially infected personnel report to shift and infecting their coworkers, a few of the fire departments surveyed implemented non-punitive leave policies for personnel with COVID-19 exposure. This type of policy allows sick personnel to take sufficient time off

to heal without feeling pressure to return to service. Policies such as these can have a significant impact on the health of an agency's personnel pool.

Absent IPC Elements.

The results of this study revealed that 16 of the recommended IPC elements were absent from every fire department plan reviewed. The missing components included recommendations related to pre-arrival instructions, the consideration of personnel family members, and the performance of debriefing processes following interactions with infected patients.

The role of the PSAP 911 dispatcher during a pandemic is crucial and should be optimized to its fullest potential. PSAP 911 dispatchers serve as a conduit of communication between the patients and the emergency crews responding to them. Even though the PSAP 911 dispatchers generally receive a minimal amount of medical training, they are still able to deliver critical pre-arrival instructions to those who call 911 for help. During a national emergency, such as a pandemic, resources will often become taxed due to the resulting patient surges. With the implementation of modified dispatching algorithms and screening, PSAP 911 dispatchers can help decrease the emergency system's strain by providing potentially infected callers with pre-arrival transport instructions and providing subacute/non-serious callers with home self-care instructions. Effective pre-arrival instructions given to potentially infected callers can help minimize the responding crews' interactions with infectious patients in poorly ventilated environments. When the PSAP 911 dispatchers instruct patients or their families collect medical history paperwork and medication lists prior to the emergency responders'

arrival, crews will not need to search the residence to locate these crucial pieces of information. This will minimize the amount of time first responders have to spend in poorly ventilated environments with patients.

Previously conducted studies have indicated that one of the primary concerns for emergency responders during infectious disease outbreaks was for their family members' health and well-being. In recognition of this fact, fire departments need to consider personnel's families when planning for outbreak events. By producing educational materials regarding the COVID-19 pandemic for personnel to bring home to their family members, agencies are given an excellent opportunity to minimize the fear and confusion that typically accompanies outbreak events. Examples of beneficial educational resources personnel can provide to their families include up-to-date viral transmission characteristics, instructions on post-exposure self-care, isolation recommendations, quarantine directives, and home social distancing recommendations.

The proper use of PPE is one of the most vital components to providing EMS responders with adequate protection against infectious disease. The significance of utilizing the proper PPE is especially true when emergency personnel are responding to and treating patients infected with a novel virus. The rapid progression of the COVID-19 pandemic has caused almost every EMS provider in the U.S. to modify their PPE guidelines and practices. Many of these amended PPE practices included the integration of additional PPE devices. Whenever new PPE components are introduced to personnel, it is imperative that they receive the proper education and training prior to using the new pieces of equipment. In reviewing the IPC plans provided, deficiencies were observed in

the education and training requirements with the introduction of the new PPE components. The introduction of new or alternate PPE components was noted in multiple agencies with no discussion on additional required training.

In the fire service, a common occurrence that typically follows the response to a hazardous situation, such as a house fire, is the completion of a debriefing process. These debriefings are generally informal practices to identify elements of the response that went well, areas that need improvement, and focus on improving personnel safety. One clear and significant hazardous event to firefighters recently has been the COVID-19 pandemic. Firefighters have been recognized as a population at an increased risk of becoming infected by this virus. Given the increased risk associated with COVID-19, fire departments should consider implementing a debriefing process following emergency runs involving infected patients. These debriefing processes may be assisted with the utilization of notecard checklists where crewmembers verify their adherence to specific IPC elements during their response. These debriefing checklists could include verification of elements such as: donning of appropriate PPE, practicing social distancing guidelines, avoidance of high-risk medical procedures, ensuring patients donned facemasks, practicing the appropriate doffing procedures, and the performance of decontamination (equipment, personnel, and emergency vehicles). During high-risk interactions, it is paramount that the appropriate IPC elements can be verified. Alternatively, non-adherence to the appropriate IPC elements must be identified early to initiate post exposure action procedures.

IPC Outliers

Reviewing the COVID-19 IPC plans from multiple fire departments provided the study with an opportunity to identify unique IPC elements not expressly defined in our IPC evaluation criteria template. One of the unique IPC elements discovered was encouragement of FF-EMTs responding to emergencies to contact the patient (or their family) by cell phone prior to the arrival on scene (if time and patient's condition permit). Establishing this communication channel allows FF-EMTs to perform additional screening questions and to provide more focused pre-arrival instructions. The additional screening can include questions relating to the patient's severity, such as their work of breathing, and could indicate the necessity of performing advanced airway intervention procedures. The additional information obtained by the FF-EMTs, who generally have more medical training than the PSAP 911 dispatcher, will provide them with a better idea of the patient's condition. This better overall picture will allow crews to bring only necessary medical equipment to the scene, minimizing the amount of equipment that needs to be decontaminated. When crews responding to the emergency conduct their own screening of the patient, the potential for message distortion of the patient's condition between EMS and the PSAP 911 dispatcher is minimized.

An additional element observed among several fire department IPC plans, not included on the IPC evaluation criteria template, was for all long-term residential facilities to be designated as "High Risk" occupancies. The denotation of establishments as "High Risk" requires all personnel who enter the facility to don the full complement of COVID-19 PPE. Introduction of policies such as these serve to better protect emergency

responders while they are in facilities caring for residents who have been recognized as high risk for respiratory pathogens, such as COVID-19 (CDC, 2020b). Fire and EMS agencies that implement policies such as these also provide the residents of these facilities with an increased amount of protection from the FF-EMTs who may be asymptomatic and COVID-19 positive. Providing the residents of these facilities with the highest level of protection is imperative, given that they typically have significant comorbidities and are the most at risk to COVID-19.

The PPE and disinfectant supply shortages experienced by health care organizations resulting from the current pandemic prompted many to implement revised disinfection practices for their vehicles, equipment, and essential PPE. Several fire departments included in this study instituted processes to disinfect all used and undamaged N95 respirators. These disinfection processes included utilizing Ultraviolet Germicidal Irradiation (UVGI) machines, allowing for the reuse and successful maintenance of the vital supply caches. Fire departments also utilized UVGI machines, ozone generators, and disinfection foggers to disinfect ambulances following a confirmed COVID-19 patient's transport. These modern disinfection practices provided agencies with an ability to continually disinfect equipment when they had difficulty obtaining traditional disinfection supplies.

Limitations

A significant limitation of this study was the small sample size of participating fire departments. Even with the inclusion of large fire departments, the small sample pool may not have accurately represented the overall fire service compliance to the industry

recommendations noted in the IPC evaluation criteria template. The fire agencies that did participate provided invaluable resources for evaluating and comparing critical aspects of their COVID-19 IPC plans; however, the documents delivered may not have provided the full view of the particular agencies' COVID-19 plan. Every fire department included in this study had their IPC elements distributed among multiple documents. Some of the fire departments had their IPC elements distributed among more documents than others. The IPC elements noted to be missing from specific fire departments may have actually been accounted for in alternate documents that were not provided to the study.

An additional limitation was that the COVID-19 pandemic was ongoing during this study. The majority of the fire departments contacted were discovered to have implemented policies mandating that all non-essential staff members were to work from home. This presented the study with multiple barriers to communicating with the appropriate agency personnel, as updated contact information on several occasions, was unlisted and challenging to access. In turn, significant barriers were experienced while attempting to make contact with personnel who were able to grant access to the requested IPC-related documents.

Given the novelty of the COVID-19 pandemic and the frequent modifications to certain IPC recommendations, several fire departments surveyed reported that they were in the process of updating their COVID-19 protocols. In reviewing the chronological IPC plan updates from several fire departments, the study noted instances of potentially confusing IPC directives. The study observed policy changes from multiple agencies

occurring several times a week. These frequent policy changes can increase the likelihood of personnel operating on outdated IPC recommendations.

The fire department plans used in this study were all from career agencies with full-time paid firefighters, serving mid to large-size metropolitan areas. In the U.S., only 33% of firefighters are full-time paid employees, with the rest being volunteer firefighters (Evarts, 2020). Larger fire departments generally have more resources and personnel available than smaller volunteer departments. Smaller volunteer fire departments may be limited in the available staff who are able to research and develop in-depth pandemic protocols.

Conclusion and Recommendations:

The COVID-19 pandemic is currently ongoing, and the full impact of this event may not be realized until long after it has concluded. One thing that is certain however, is the dramatic effects that this pandemic has had on U.S. emergency services. Fire departments across the nation have implemented significant changes to their operational plans to protect personnel and the communities in which they serve. Many of the response policies were amended numerous times after their initial development to comply with the results of the latest scientific research. In several fire departments, the updated plan policies were delivered among various departmental documents, creating confusion and potential for adherence to outdated policies. Every fire department reviewed was discovered to have implemented appropriate guidance on the necessary PPE during interactions with potentially infected patients and were also found to possess IPC plan elements needing improvement. Fire departments have established innovative practices

focusing on optimizing available PPE to maintain vital supply caches in the face of substantial global shortages. The COVID-19 pandemic has changed the very definition of normal operations within the fire service. This pandemic has called attention to many of the issues experienced during outbreak events, indicating the need for additional research and development in infectious disease response and emergency services preparation.

TABLE 7: IPC evaluation review criteria

Pandemic Plan Elements:	FD1	FD2	FD3	FD4	FD5	FD6	Full Score
Dedicated staff position responsible for infectious disease preparedness	1	1	1		1	1	1
All personnel are provided with copies of pandemic policies	1	1	1	1	1	1	1
Plan is developed in coordination with local healthcare partners (Hospitals, neighboring fire departments, public health department, nursing homes)	1	1	1	1	1	1	1
Personnel are provided with details about pandemic infection prevention and control practices	1	1	1	1	1	1	1
Public Safety Answering Point (PSAP) Modified Screening Questions							
The plan indicates the implementation of modified call taker screening criteria	1	1	1	1		1	1
Signs and symptoms of infection	1	1	1	1		1	1
Travel history to effected regions	1	1		1		1	1
Known contact with infected persons	1			1		1	1
Additional persons at the location with signs and symptoms of infection				1		1	1
Call taker records call back phone number and relays this to responding crews	1		1				1
Call takers provide responding EMS with early notification of positive infection screening	1	1	1	1		1	1
Plan lists the following pre-arrival instructions							
Call taker instructs family members or patient to assist with:							1
Expediting access to patient							1
Preparing patient for transport							1
Compiling list of medications							1
If patient condition allows, request should be made for the patient to meet crews outside							1
Infectious Disease Training							
The plan includes the following items							
All non-essential in person training is postponed in favor of pandemic specific virus-related training.	1		1	0.5*			1
Training is provided on updated response protocols before they are implemented							1
Proper PPE Donning and Doffing procedures	1	1	1	1		1	1
Personnel shall demonstrate PPE donning and doffing competencies							1
Personnel family members are provided with training materials							1
Training includes decontamination procedures on							
Station		1				1	1
EMS equipment	1	1				1	1
PPE	1	1				1	1
Vehicles		1				1	1
PPE							
PPE equipment caches are maintained, appropriate quantities can be determined using tools like those supplied by the CDC's PPE Burn Rate Calculator or equivalent.	1	1	1				1
PPE contingencies are developed (i.e. re-use recommendations, alternative PPE components)		1	1		1	1	1
Specific PPE criteria is provided for the call type and patient symptomology	1	1	1	1	1	1	1
Strategies in place to optimize PPE supplies:	1	1	1		1	1	1
Limiting personnel interactions with PUI	1	1	1	1	1	1	1
Utilizing reusable PPE	1	1	1	1	1	1	1
Limited reuse of disposable PPE		1	1		1	1	1
Plan lists use of the following PPE							
Eye protection – face shield or goggles	1	1	1	1	1	1	1
Respiratory protection (N95) or better	1	1	1	1	1	1	1
Use of filtered respirator exhalation valves (if present)		1					1
Gowns or Tyvek suits	1	1	1	1	1	1	1
Single pair of gloves	1	1	1	1	0.5*	1	1
Boot covers	1						1
Donning PPE							
Checklist is utilized							1
Level of PPE is determined based on reported patient symptomology and departmental guidance	1	1	1	1	1	1	1
PPE is inspected to ensure it is serviceable (i.e. no cuts or tears, appropriate size)			1	1			1
Hand hygiene is performed	1			1			1
PPE is donned in correct order according to departmental guidance	1			1	1	1	1
Integrity of ensemble is verified by personnel prior to patient contact				1			1
Doffing PPE							
Checklist is utilized			1				1
PPE is inspected for damage prior to doffing			1				1
PPE is doffed in designated areas.	1		1	1			1
Appropriate doffing procedures developed by agency	1		1	1	1		1
Hand hygiene is performed	1		1	1	1		1
If personnel duty uniform under PPE is discovered to have become soiled, personnel will return to station for uniform change	1	1	1	1			1
Soiled uniform items will be washed at station with disease prevention guidelines	1	1	1	1	1		1
Fire Department Facilities							
Non-essential personnel work from home and are provided the resources to do so	1		1				1
Sick personnel are directed to stay home	1	1	1	1		1	1
Personnel screening process is implemented at the beginning of each shift	1	1	1	1		1	1
Visitors are restricted from entering facilities	1	1	1	1			1
Mask use is required during entire shift	1	1	1	1		1	1
Promotion of social distancing	1	1	1	1		1	1
Personnel uniform items kept at station			1				1
Hand sanitizer dispensers are readily available				1			1
Off going personnel shall shower before going home			1	1			1
Station ventilation practices are optimized							1
Patient Treatment Practices							
Personnel are instructed to avoid touching their face		1	1		1		1
Hand hygiene is performed before and after all patient contact	1	1		1	1	1	1
Perform infection screening on all patients	1	1	1	1	1	1	1
Ensure patient and family are wearing face masks during all interactions	1	1	1	1	1	1	1
N95 or better respiratory protection will be worn by personnel on all patient interactions	1	1	1	1	1	1	1
Patients should be moved outside	1	1		1	1	1	1
Limit number of personnel who contact patients	1	1	1	1	1	1	1
Avoid interacting with patient and family in poorly ventilated environments		1		1	1	1	1

Hospital information is left with family so that they may call for an update.							1
If patient requires O2, airway device is placed with continued use of face mask	1	1	1	1	1	1	1
Only necessary equipment is brought to the scene to avoid unnecessary equipment contamination	1		1			1	1
Implementation of modified treat and release policies	1	1	1			1	1
Aerosol-generating procedures are defined and discussed	1	1	1	1	1	1	1
Supplement metered dose inhalers instead of nebulizers	1	1	1			1	1
HEPA filter use on advanced airway exhalation ports.	1	1			1	1	1
Patient belongings are considered contaminated and placed in a biohazard bag, sealed, and labelled.							1
Early notification of a suspected COVID-19 patient to the receiving facility.	1	1	1	1	1	1	1
Cleaning and Disinfection Procedures							
Decon procedures for Station facility	1	1	1	1	1	1	1
Decon procedures for EMS equipment	1	1	1	1	1	1	1
Decon procedures for PPE	1	1	1	1	1	1	1
Decon procedures for department vehicles	1	1	1	1	1	1	1
Frequent hand hygiene is encouraged	1	1	1	1	1	1	1
Establishment of Approved Disinfectants	1	1	1	1	1	1	1
Use of disinfectant wipes opposed to spray, when in enclosed compartments				1			1
Biohazard cleaners contracted for gross station decontamination	1		1	1			1
Facility outbreak is declared if a workplace has 2 or more confirmed or probable infection cases within a 14 day period.			1	1		1	1
Decontamination checklists created and provided to crews			1	1		1	1
Post Exposure Definitions and Actions							
Low-Risk Exposure (exposure to infected individuals while following infection prevention guidelines)– twice daily self-assessment, monitor for s/s, no work restrictions	1	1	1			1	1
High-Risk Exposure (personnel without appropriate PPE, who interreact within 6 feet of infected individuals for 15 minutes or greater; or who are exposed to infectious secretions for any amount of time)	1	1	1	1	1	1	1
14-day quarantine and self-monitor for s/s of infection							
-or-							
Quarantine for 10 days, if no symptoms have been observed following daily monitoring, work restrictions are concluded	1	1	1	1	1	1	1
-or-							
Quarantine is discontinued after Day 7, following a diagnostic specimen negative test, with no observed symptoms during daily monitoring.		1				1	1
Agency provides testing for potential exposures, at no cost	1		1	1		1	1
Contact Tracing & Documentation							
Personnel who develop signs and symptoms of infection shall self-isolate and notify agency infection control officer.	1	1	1	1	1	1	1
Personnel with on the job exposures are documented and communicated with the local health authorities to ensure accurate contact tracing is performed	1	1	1	1	1	1	1
Every contact with a PUI is documented through an agency established reporting system.	1	1	1	1	1	1	1
State or local public health authorities are notified of all PUI.		1	1		1	1	1
Continuity of Operations – Workforce Protection							
Nonpunitive sick-leave policies are developed for personnel with exposures while on duty.	1	1	1				1
Maintaining contact with employees in quarantine and planning for their replacements.			1			1	1
Vaccinations are strongly encouraged	1	1				1	1
Novel virus vaccine delivery plans are developed for the rapid vaccination of all department personnel.	1	1				1	1
Additional emergency response vehicles are staffed to meet patient surge needs	1	1					1
Non-essential department personnel are reassigned and retrained to assist in mission essential tasks.			1				1
Mental health counseling resources are available, and personnel are encouraged to seek assistance if the need should arise.	1		1		1	1	1
Telecommuting tools provided for non-essential employees and leadership	1		1				1
Return to work policies are in place for infected personnel who have recovered	1	1	1	1	1	1	1
Development of procedures to hire back retired or previously active members to assist if personnel staffing becomes an issue.							1
Ambulance Operations							
Optimized ventilation strategies in ambulance	1	1			1	1	1
Driver and patient compartments are separated.	1	1			1	1	1
PPE guidelines are in place to prevent contamination of driver compartment	1			1	1	1	1
Additional passengers (family, etc.) shall not be transported.					1		1
Non-essential compartments and cabinets for patient care are sealed.		1					1
All documentation is performed after the transport is complete, no patient care documentation is to be performed in the patient compartment.							1
Personnel shall perform debrief at the conclusion of transport to verify appropriate infection control procedures were followed throughout mission.							1
PUI transfer of care process into the hospital is developed according to local guidelines, to minimize interaction with unprotected individuals	1	1				1	1
Special Considerations							
Pediatric patient considerations							1
Geriatric patient considerations	1	1					1
Total:	77	71	72	62	48	71	117
DOCUMENTS ACCESSED:	26	46	6	4	7	10	

SOURCES:

1. Centers for Disease Control and Prevention (CDC)
2. World Health Organization (WHO)
3. U.S. Fire Administration (USFA)
4. International Association for Fire Fighters (IAFF)
5. Technical Resources, Assistance Center, and Information Exchange (TRACIE)
6. Association for Professionals in Infection Control and Epidemiology (APIC)
7. Occupational Safety and Health Agency (OSHA)
8. The Federal Healthcare Resilience Working Group (HRWG)

Disclaimer - many of the recommendations were promoted by more than one of these organizations

CONSISTENCIES AMONG PARTICIPATING AGENCIES:

All organizations included these IPC elements - 29

All organizations disregarded these IPC elements - 16

66-83% of the organizations included these elements - 33

16-50% of the organizations included these elements - 39

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