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Combating Firefighter Line of Duty Injuries

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Abstract

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MS, Southern New Hampshire University, 2010

BS, Granite State College, 2007

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Firefighter injuries add significant costs to fire department budgets and negatively impact operational readiness. Fire service leaders who lack strategies to minimize firefighter injury risk increased department costs and reduced operational readiness. Grounded in transformational leadership theory, the purpose of this multiple case study was to explore strategies fire service leaders use to minimize firefighter injuries. The participants included fire chiefs in New Hampshire and Massachusetts who successfully implemented strategies to minimize firefighter injuries. Data were collected from semistructured interviews and a review of fire department policies and records concerning firefighter injuries and injury prevention. Thematic analysis of the data resulted in the following emergent themes: administrative policies and procedures, personal protective equipment programs, apparatus and equipment design changes or purchases, wellness or fitness programs, physical and mental assessments of firefighters, education and training aimed at firefighter injury reduction, and personal protective equipment for multiple purposes. A key recommendation is developing and nurturing relationships to inspire injury reduction strategies. The implications for positive social change include reduced human suffering and reduced operational and financial impact on local municipalities.

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Dedication

This paper is dedicated to my wife, Barbara, my daughters, Ashley and Amanda, and my granddaughter, Aubrey. My wife has always been my biggest supporter in any endeavor I have chosen to undertake, she is an incredible partner and true soulmate. My daughters, Ashley, and Amanda, have grown into beautiful young women who have encouraged me through this journey. My granddaughter, Aubrey, has been patient while Grandpa spent many precious hours studying and writing when she wanted to be at the park. I also want to dedicate this to my parents for instilling values and a strong work ethic. I know my mother, who is no longer alive, is proud of what I have accomplished, and she is part of why I have. My father, who I learned from that hard work creates opportunity, and without whom I would most likely never have become a firefighter. Everything I have accomplished is because of all of you.

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Section 1: Foundation of the Study

Background of the Problem

Firefighting is a dangerous profession requiring responses to all types of emergency and nonemergency situations. Firefighter emergency responses include structural fires, motor vehicle accidents, industrial accidents, hazardous materials incidents, medical emergencies, and more (USFA, 2016). Because of the very nature of work firefighters perform, they are at a high risk of injury while performing those duties (Hardison, & Gray, 2021). Non emergency situations include training, inspections, and activities around the fire station among others (USFA, 2016). The U.S. Fire Administration (USFA) tracks fire-related data through the collection of incident reports through a program called the National Fire Incident Reporting System (NFIRS) as submitted by fire departments nationwide (USFA, 2019). The NFIRS includes information about the types of responses firefighters respond to as well as firefighter and civilian casualty data.

The USFA (2019) estimated there were 63,000 total duty injuries to firefighters annually with more than 25,000 occurring on the fireground between 2015 and 2017. The fireground is where firefighters are engaged in typical firefighting activities, such as fire suppression, rescue efforts, extractions, and other actions. These figures represent a drop in average from more than 66,000 total duty-related injuries and 29,000 fireground injuries between 2010 and 2014 (USFA, 2016) but still represent significant operational and financial impacts on fire departments nationally.

Problem Statement

The USFA (2019) estimated the number of overall firefighter injuries to be 63,000 between 2015 and 2017. The annual cost of injuries to firefighters in the United States is

approximately $5.9 billion (Butry et al., 2019). The general business problem was that fire service injuries influence the operational readiness of firefighters and are costly to the municipalities they serve. The specific problem was some fire service leaders lack strategies to minimize firefighter injuries.

Purpose Statement

The purpose of this qualitative, multiple-case study was to explore strategies that fire service leaders use to minimize firefighter injuries. The targeted population consisted of fire service leaders from organizations in New Hampshire and Massachusetts who have implemented successful injury prevention measures. Pollack et al. (2017) posited that the implementation of risk management programs could have a positive impact on the injury-causing behavior of firefighters. The implications for social change stem from decreasing injuries to firefighters, thereby reducing human suffering and the negative economic impact to fire departments and, ultimately, taxpayers.

Nature of the Study

The three methods a researcher can choose are qualitative, quantitative, and mixed (Hughes, 2016). The method a researcher uses identifies how data will be collected, analyzed, and interpreted (Abutabanjah & Jaradat, 2018) and is based on the goal of their research (Basias & Pollalis, 2018). The qualitative method is used to demonstrate experiences or study phenomena to gain a better understanding of an issue (Cruz & Tantia, 2017). Using a qualitative method, data can be gathered using interviews, by observation, or through using focus groups as opposed to collecting numerical data as in a quantitative approach (Hughes, 2016). The quantitative method is more appropriate for fact-based research that may be based more on numerical data and the use of closed questions in the research questions (Basias & Pollalis, 2018). The mixed method is a

combination of both qualitative and quantitative methods. I chose the qualitative method for this study because it allowed me to explore the experiences of fire service leaders who have implemented strategies that have proved successful in reducing firefighter injuries.

A research design outlines the plan for a researcher to conduct research (Abutabanjah & Jaradat, 2018). I employed a multiple-case study design to answer the research question and provide depth to this research study. Researchers use a case study design to examine the experiences of their study participants and explore an issue or phenomena occurring within a group (Harrison, Birks, et al., 2017). Case study research is used to study real issues that are happening to specific cases (Ridder, 2017). I chose case study research because it is useful in researching real issues, such as injuries to firefighters, that have impacted each of the participants. I asked open-ended interview questions during semi structured interviews to gather data. Random sampling can also be used as a case study method (Ridder, 2017), but I felt that there would too many variables that may influence the answers during a random sampling process. Ridder (2017) suggested that a researcher performing a single-case study may have an advantage because they can provide a more detailed approach to the issue they are researching. I chose to do a multiple-case study with participants from the same area of the northeast because I thought this approach provided the study with depth by collecting the experiences of multiple people as opposed to a single case. I considered the participants to have similar experiences because they were in the same profession, and all had felt the impact of firefighter injuries to the degree it prompted them to implement injury reduction strategies. The case study participants had many factors related to injuries in common, such as weather, building construction, fire safety laws, and regulations, to name a few. I also chose a multiple-case study over a single case study because while each participant had similar backgrounds and injury-causing factors, how they have dealt with the issue of firefighter injuries may have varied and each participant had their own experiences that

added to the collection of data. I believe the multiple-case study design provided me with multiple successful strategies, creating a better understanding of how to help fire service leaders who lack strategies to reduce firefighter injuries.

Research Question

What strategies have some fire service leaders implemented to minimize firefighter injuries?

Interview Questions

1. What strategies has your organization implemented to minimize firefighter injuries?
2. What has been the single biggest contributor(s) to your firefighter injuries?
3. What areas (i.e., operational, administrative, safety, etc.) has your organization addressed to reduce firefighter injuries?
4. Have the strategies your organization implemented addressed personal protective equipment?
5. How much of a reduction in injuries has your organization realized through injury reduction strategies?
6. On a per annum basis, what type of a reduction in financial impact has your organization realized because of injury reduction strategies that have been implemented?
7. Could you define the leadership approach that was employed to implement your injury reduction strategies?

Conceptual Framework

According to Burns (1978), transformational leadership occurs when leaders influence and inspire others to implement change by putting organizational interests ahead of self-interest. Burns opined that leaders could form, change, and lift subordinates' motives and goals, thereby creating a transformation. Transformational leadership involves leaders influencing the behavior and ultimately the performance of others (Jiang et al., 2017). Transformational leadership theory involves an organizational leader engaging subordinates to motivate them and improve performance (Thomas, 2017b).

Transformational leadership was the lens through which I conducted this study. Pollack et al. (2017) advocated the fire service adopt a risk management approach to operations to help reduce the incidence of firefighter injuries. Risk management properly implemented is appropriate because researchers have demonstrated that behavior can be influenced to the point where it can impact injuries to firefighters (Pollack et al., 2017). Successful implementation of approaches such as risk management may require a transformational leadership approach.

The purpose of this study was to explore strategies fire service leaders have successfully implemented to reduce firefighter injuries, thereby lessening human suffering and the negative economic impact of such injuries. Studying what strategies other fire service leaders have successfully implemented may allow me to provide examples of successful strategies that other fire service leaders can use to achieve the same results.

Operational Definitions

Body composition: A measurement of the body's ratio of fat to muscle to determine fitness levels. Practitioners can use multiple techniques to determine body composition, such as

the body mass index (BMI), waist circumference measurements, and bioelectrical impedance analysis (Kaipust et al., 2019).

Injury: Anything that someone has or should have sought treatment by a medical professional for (Kaipust et al., 2019).

Personal protective equipment: Equipment worn by firefighters to protect from specific hazards associated with their jobs (Amidon et al., 2018).

Posttraumatic stress disorder: A condition that can be debilitating that occurs following a traumatic exposure (Lee et al., 2017).

Assumptions, Limitations, and Delimitations

In this section, I provide the assumptions, limitations, and delimitations under which this study was conducted.

Assumptions

Assumptions are beliefs or information the researcher has accepted as true even if they cannot be proven as fact or validated. I assumed that all participants were contributing to my research voluntarily, were representative of other fire department leaders who have been impacted by firefighter injuries and would be honest in their responses to interview questions.

Limitations

Limitations are factors that hinder the research and are out of the control of a researcher. Limitations may be closely related to the research being conducted and may pose a restriction of some type (Theofanidis & Fountouki, 2018). In this study, I interviewed participants who may have lacked accurate recall or who might have answered an interview question in a way that they

thought I wanted to hear instead of focusing more on accuracy. The current COVID-19 pandemic may have contributed to limitations that could not have been identified prior to my interviews with case study participants. These factors could have impacted the accuracy of data collection. The research results were limited to the scope of the research question focused on strategies that have been implemented by fire service leaders. Other successful strategies may be available to leaders but have not yet been implemented, limiting the possibility of them being identified during this study.

Delimitations

Delimitations define the scope of a study and could restrict the conclusions. Delimitations may be described as boundaries the researcher chooses to set for a variety of reasons, such as a lack of resources, ethical considerations, or other factors the researcher feels are tied to their research (Theofanidis & Fountouki, 2018). The population of interest chosen as case study participants, fire departments in New Hampshire and Massachusetts, limit the scope regionally. This study only focused on fire service leaders and did not include firefighters or company level officers.

Significance of the Study

Injury rates of firefighters in the United States remain high with over 22,000 occurring on the fireground alone in 2018 (USFA, 2020). The high rates of injury remain despite a long-term drop in responses to structural fires, better equipment, training, and technology advances. As annual injury rates remain at a high level, so do the economic impact of those injuries on local municipalities and the injured firefighters, which is estimated to be as high as $5.9 billion annually (Butry et al., 2019). The noneconomic cost is the human suffering that occurs with each injury and firefighter death.

Contribution to Business Practice

The fiscal impact of firefighter injuries is difficult to quantify. A study commissioned by the National Institute for Standards and Technology (2005) put the total cost of injuries to firefighters between $2.8 and $7.8 billion. The National Institute for Standards and Technology study included multiple factors to capture the overall cost related to firefighter injuries, including insurance costs, medical bills, cost of backfilling for injured firefighters, and preventive measures among other factors. More recent estimates put the cost of injuries to firefighters in the United States at $5.9 billion annually (Butry et al., 2019). If injuries sustained by firefighters are reduced by as little as 10% annually, there would be a financial savings of hundreds of millions of dollars to insurance carriers; municipalities; injured firefighters; and, ultimately, the taxpayer. With such significant savings, fire departments could reallocate funding for the increased training of firefighters and implement programs to further respective organizational missions.

Implications for Social Change

Firefighters in the United States continue to suffering as many as 63,000 annual injuries (USFA, 2019). A reduction in overall firefighter injuries would reduce human suffering and reduce the overall cost associated with firefighter injuries as well. Each injury to a firefighter impacts not only the injured firefighter but their families and coworkers. Reducing firefighter injuries allows firefighters who may be injured to continue leading a normal life without limitations that could impact them or their families. A reduction in firefighter injuries also lessens the fiscal impact of such injuries and can increase the organizational efficiency and longevity of firefighting companies while reducing costs to the taxpayer at the local level.

A Review of the Professional and Academic Literature

I conducted this review of relevant literature on the topic of firefighter injuries and strategies with the aim of preventing or reducing injuries. Literature reviews are undertaken to provide a researcher with increased knowledge on a subject through the analysis and synthesis of timely research on a given topic. A literature review adds to the understanding of a topic by building on the research, and the findings of others (Paul & Criado, 2020). In this literature review, I focus on the overall problem of firefighter injuries and the fiscal impact on organizations resulting from firefighter injuries. Additionally, direct, and indirect causes of injuries are reviewed as are prevention methods. Lastly, I discuss literature about applicable leadership approaches to solving the overall problem and the impact of firefighter injuries to produce potential strategies to reduce firefighter injuries. The literature review is broken down into specific areas referencing different parts of the overall business problem or potential solutions to the business problem.

I searched multiple databases to find suitable peer-reviewed sources of literature, including EBSCO, Business Source Complete, and Google Scholar. The following keyword search terms were used: *firefighter injuries, the impact of firefighter injuries, causes of firefighter injuries, preventing injuries to firefighters, fitness levels of firefighters, the fiscal impact of firefighter injuries, the economic impact of injuries, consequences of firefighter injuries, transformational leadership, fire service leadership, transformational leadership in the fire service,* and *leadership styles*.

Most of the literature included in this review was published in 2016 or later. This ensured that most of the work examined was published within the last 5 years or less, with the remaining work comprised of historic research that remains relevant. Literature must remain relevant to the

topic being studied, and ensuring the work being reviewed is within the 5-year timeframe safeguards the researcher from using outdated and possibly irrelevant material. I reviewed over 140 peer-reviewed articles or government publications to ensure a comprehensive analysis of the research topic; over 90 of these sources are cited in the literature review.

Firefighter Injuries

There are more than 1.2 million active firefighters in the United States (USFA, 2020). Firefighters respond to types of emergencies that, at times, can be very labor intensive and require firefighters to go from a stationary position to constant active movement within minutes, making them susceptible to injuries. Firefighters respond to every type of emergency service request and perform difficult tasks, including fire suppression, rescue of trapped or injured victims, climbing in and out of vehicles and up and down ladders, and advancing heavy hoses among others (Orr et al., 2019). The USFA collects data on injuries from fire departments who report their incident and injury data to the NFIRS.

In 1981, the first year firefighter injury statistics were published, the total number of injuries suffered by firefighters was 103,340. In 2015, the total number of injuries reported for firefighters in the United States was 68,085 (Haynes & Molis, 2016). The total number of injuries includes all injuries associated with firefighting activities, not just injuries suffered on the fireground. Between 1981 and 2015, fireground injuries dropped from 67,500 to 29,130 (Haynes & Molis, 2016). This is significant because total injuries have dropped less than 35% despite a drop in structural fires of almost 52% during the same period. Despite the fireground being the most dangerous place for firefighters to operate, fireground injuries have decreased at a 56% rate since 1981, slightly ahead of structural fire decreases.

Leadership Models

Leaders often act in multiple roles to help forward the mission or vision of their respective organizations. Organizational leaders are essential drivers of the behavior of subordinates as it applies to organizational effectiveness (Drewniak, Drewniak, & Posadzinska, 2020). Two of the many key leadership methods are transformational and transactional (Burns, 1978). Both rely on the followers' engagement and adherence to the organizational structure in exchange for an improved situation; however, the main difference between the two is rooted in the method of motivation. One relies on the character of the leader to stimulate and inspire their followers', while the other works through an exchange system or the promise of a reward or punishment for follower (Changar, & Atan, 2021). Striving to reduce the incidence of firefighter injuries and the impact of those injuries requires strong leadership skills aimed at transforming the behavior of firefighters.

Transformational Leadership

Transformational leadership theory was first put forth by Burns (1978). Transformational leadership involves leaders engaging subordinates in a way that influences and motivates them using rewards to create wins for subordinates and the organization (Deshwal & Ali, 2020). Burns stated that the transformational leader creates mutual stimulation between the leader and the follower working to develop an additional leader of the follower. Burns opined that the transformational approach was where a leader connects with subordinates by appealing to them on an ethical level to put the community before self-interest by emphasizing ethical ambitions. A leader using a transformative approach often looks for motives in followers and seeks to find and mentor the needs of followers. Transformational leaders seek to improve the situation so that both the leader and follower rise to successively higher levels, fulfilling both of their needs. Burns put

forth that leadership itself is a choice between alternatives and that transforming leadership in and of itself was a form of intellectual leadership based on conscious purpose founded on values. The transformational leader must choose a course for the organization that will result in beneficial outcomes, even if the leaders and followers have different motivations for achieving the desired effect.

The purpose of transformational leadership is to create meaningful change for an organization. Transformational leadership approaches in a group setting have demonstrated a positive impact on both individuals and teams as it applies to innovation (Li et al., 2016). Transformational leadership has been proven to impact the performance of subordinates and increase productivity (Ng, 2017). Transformational leadership has been shown to influence the sustainable performance of subordinates by creating a more cooperative atmosphere in an organizational setting (Jiang et al., 2017). Transformational leaders can influence and motivate subordinates by setting a vision and providing challenges for those subordinates (Copeland, 2016). Inspiring subordinates to create goals in which those of the organization and the individual align is known as idealized influence and helps transformational leaders create change as well as an organizational improvement (Orabi, 2016). Any organization wants more productivity out of its personnel whether they are profit-based or serviced-based organizations. Transformational leadership has been proven to be successful, and the success may be tied to both its recognized subdimensions and the follower's service motivation. Organizational leaders should recognize the need for motivated followers who believe in the mission of an organization or proposed change initiative and must work to generate idealized influence by creating a vision with the motivation of the follower in mind.

Transformational leadership seeks to create change and can be predicated on the behavior of leaders as well as subordinates. Leaders seek to influence behavior in subordinates and may use a variety of methods or inherent traits to help accomplish change. Researchers conducting a study involving public safety employees in Mexico drew a correlation between leader behavior and organizational citizenship behavior by followers. The cliché of leading by example has proved to influence followers, as has the leader's public service motivation, or how dedicated they are to the organizational mission (Bottomley et al., 2016). Traits such as drive, honesty, self-confidence, and willingness to lead have been linked to leadership (Drewniak et al., 2020).

Transformational leadership has proven to have a positive influence on innovation within a group setting. Transformational leaders help build employee motivation in subordinates by creating challenging goals (Li et al., 2016). Creating change in organizations may require leaders to accurately convey their vision of change (Stouten et al., 2018). Aga et al. (2016) posited that transformational leaders can positively impact projects by using transformational leadership to build teams. Transformational leaders can influence follower behavior by developing their leadership skills, creating an atmosphere of responsiveness, openness, fairness, and strong ethical values while building and supporting the capabilities of subordinates creating future organizational leaders while influencing their behavior (Day et al., 2016). Organizations in any type of industry need employees who are energetic, enthusiastic, and engaged, and this can be accomplished in part through transformational leadership (Baker, 2017). Whether a transformational leader uses innovation or reliance on their strong character traits, it is clear this type of leader impacts the desired outcome.

Authentic leadership behavior has been described as an alignment between the internal thoughts of a leader and the outward actions they display (Gill et al., 2018). Transformational

leadership focuses on creating organizational change based on a clearly articulated vision. Focusing on creating a culture of innovation and follower development can make the subordinates a catalyst for the desired change. In developing followers, transformational leaders are demonstrating they are working for the best interests of the group above self-interest. Showing authentic leadership behavior can assist the leader in achieving the goal of shifting the culture from self-interested one to one that is group interest based.

Rather than rewarding the targeted behavior, transformational leadership focuses on changing the mindset of subordinates and is not a simple reward system like transactional leadership. Transformational leadership can measure success or failure as a business application. Transformational leadership can create trust and improve organizational effectiveness through clarity of vision, determination, strong ethical values (Day et al., 2016). When properly applied, transformational leadership can create an innovative work culture in organizations, leading to overall improvement by enhancing employee behavior (Khan et al., 2020). Effective transformational leadership can inspire employee engagement through providing support and creating a clear vision for the organization (Sahu et al., 2018). Organizational effectiveness can be improved through the transformational leader building a more effective team to improve project success (Aga et al., 2016). Orabi (2016) posited that transformational leadership impacts employee behavior thus improving organizational performance by improving the organizational environment and sharing of knowledge. Influencing behavior is the goal of any type of leadership behavior and transformational leadership, when properly applied, can accomplish this goal.

A principle in the theory of transformational leadership is that changes are deep seated and not superficial. Deep-seated changes are necessary for sincere behavior modification. One of the values of transformational leadership is it can be performed by members of different levels

within an organization (Montouri & Donnelly, 2017). This approach, therefore, can be successful in both upper and lower organizational ranks.

As it applies to change in fire service behavior with the overarching goal of reducing injuries, the principle that transformational change can happen at multiple levels is important. Evidence suggests that transformational leadership can have a sustained impact on the performance of employees in an organization (Jiang et al., 2017). If injury rates in firefighters can be tied to behavior, then a transformational leadership approach may contribute to a successful injury reduction strategy. The organizational leader must demonstrate that employees should be working on reducing injuries for the good of the organization. In the case of injuries, the reduction of said injuries also creates a personal benefit to the employee, thereby creating a situation where both the leader and follower benefit, which is an example of transformational leadership. If behavior modification reduces the number of injuries to firefighters, the influence that transformational leadership can have on the overarching problem of firefighter injuries and the impact of those injuries is profound.

Smith, DeJoy et al. (2020) conducted research on an offshoot of transformational leadership they referred to as safety specific transformational leadership (SSTL). SSTL is still a form of transformational leadership because it seeks to create a positive behavior that is in the best interests of both leaders and followers. Smith, DeJoy et al. (2020) focused on increasing compliance with personal protective equipment (PPE) use by firefighters, and their findings support behavioral change resulting in increased use of PPE when applying the concepts of SSTL. This is significant because PPE usage has a direct correlation to injury prevention in firefighters.

Other researchers have suggested that transformational leadership is tied closely to authentic leadership. Authentic leadership is a transparent aspect of leadership where the leader demonstrates an increased awareness of self and clarity of vision where they can be more open and honest (Banks et al., 2016). Copeland (2016) posited that authentic leaders using an ethical and transformative approach are more effective than leaders utilizing other leadership approaches. An authentic approach would seem to be an appropriate aspect of transformational leadership because it supports behavioral change among the group and not just singling out followers. Therefore, authentic leadership is a natural extension of transformational leadership in that the leader is also motivated to self-improve to influence the followers.

Public-sector employment is different than private-sector employment, and as such public-sector organizations may have different value systems. Transformative leaders in the public sector can use their influence to ensure the values of both the organization and the employee are closely aligned to increase organizational effectiveness (Pandley et al., 2016). Leadership approaches in the public sector also include aspects that may not be needed in the private sector, such as political loyalty or rule-following methods (Tummers & Knies, 2016). Bottomley et al. (2016) studied the citizenship behavior of employees based on transformational leadership and found that the idealized influence and subsequent change that transformational leadership creates is accomplished through intellectual stimulation and individualized consideration, both of which are reliant on the transformational leader creating an appealing vision (Bottomley et al., 2016). An organizational leader will try to solve a problem, such as firefighter injuries, through strategies aimed at improving outcomes by altering citizenship behavior through increased employee motivation.

Sandrin et al. (2019) researched firefighters' self-directed and measured motivations on their perceptions of health, stress, and how they performed. Research indicates that both employee's wellbeing and performance within their organization are tied directly to their workload and that autonomous motivation is positive, overall workloads should be closely monitored. Self-directed, or autonomous motivation toward workload can have a positive impact on firefighters' perceptions of their overall stress and health (Sandrin et al., 2019). Transformational leadership within the realm of public service is inclined towards the intrinsic aspirations of an employee which tend to focus on personal development and advancement over financial advances.

Controlled motivation conversely breaks down to extrinsic motivation whereby employees are motivated by something other than themselves. Impersonal motivation is focused on avoiding assessments and failures (Deci et al., 2017). Research on spiritual leadership by Ali et al. (2020) suggests it can increase safety compliance and safety participation among employees. Spiritual leaderships is the values, attitudes, and necessary behaviors a person needs for self-motivation. Other research studying public employees concluded there is a direct correlation between an employee's intrinsic motivation and their performance as an employee (Deci et al., 2017). Research by Koole et al. (201) centers around the self-determination theory. One of the characteristics of the self-determination theory is that it fulfills a psychological need to bring about a person's wellbeing through autonomy and competence, particularly in the workplace (Koole et al., 2017). Spiritual leadership focuses on the leader building a relationship with others that promotes a feeling of wellbeing among employees (Ali et al., 2020). Building positive relationships is part of transformational leadership and as such it would seem that spiritual leadership can be an additional tool for the transformational leader. The desire for organizational support as opposed to monetary compensation as an intrinsic motivator is

important, as they apply the leadership approach to organizational change. A transformational approach and not a transactional approach in producing injury reduction strategies in public service is logical, based on the psychological needs of employees tied to employer support rather than just monetary benefits.

Transactional leadership is based on both the leader and the follower creating a gain in a situation where change needs to occur. Transactional leadership is generally considered a quid pro quo scenario. Behavior is rewarded upon adherence, and there is a benefit to both the leader and follower present. An example of transactional leadership would be a political situation where favor is granted in exchange for future consideration on a different matter or policy (Burns, 1978). This sets up a reward for the leader, who receives the change desired in exchange for the other party receiving something of value to them in return. Transactional leadership can also lead to the punishment of a subordinate for lack of compliance if it has an impact on the organization's mission (Deshwal & Ali, 2020).

Transactional leadership provides the subordinate with some type of reward, or punishment avoidance in exchange for compliance with the leader's request (Kark et al., 2018). In many cases, the reward for increased productivity using the transaction theory is based on a monetary incentive. In a service-based industry such as public safety, there may be some financial incentives built to motivate employees, but this may not be realistic across all communities to successfully implement beneficial organizational change, which causes us to examine transformational leadership as a more practical leadership approach.

Injury Analysis

Firefighters can be injured in any type of situation or location. The most common time of day in which fires occur that result in firefighter injuries is in the afternoon and early evening

between 1:00 p.m. and 7:00 p.m. accounting for 33.5% of fires. The most common month for fires to occur causing injuries to firefighters is in July, accounting for just fewer than 11% of the total. Historic records indicate that the location of where firefighter injuries are occurring is ever-changing. However, the fireground is the area where most firefighters are injured. The breakdown of the 2015 line of duty injuries by the National Fire Protection Agency (NFPA) puts the percentage of fireground injuries at 43%. In comparison, other injury categories break down as 21% of injuries occurring in non-fire emergencies, 19% occurring in another type of duty, 11% occurring in training, and the remaining 6% resulting from response to accidents or returning from an incident location (Haynes & Molis, 2016). Fireground injuries have dropped in proportion to the number of fires since 1981 but remain the highest category of firefighter injury, although the gap between fireground and non-fireground injuries is closing. Since then, the occurrence of injury per 1,000 emergency incidents has fallen by 64%. However, the data shows that the number of injuries in non-fire emergencies has grown by over 49% since 1981. Non-fire emergencies include training, maintenance, exercise, fire inspection, motor vehicle collisions, and other locations around the firehouse. In 2015, 3,800 firefighters were injured responding to or returning from an incident. An additional 7,560 firefighters were injured during training, and 13,275 injured in other non-emergency situations while on duty. Despite temporary spikes or downtrends, injuries to firefighters involved in fire apparatus collisions had remained consistent despite a steady rise in collisions annually between 1990 and 2015 when apparatus collisions went above 16,000 in a year for the first time. The decline in injuries despite the rise in collisions may be attributed to a nationwide push for seatbelt usage and increased safety features in newer fire apparatus but no data support this theory. Between 1990 and 2015, the numbers for firefighters involved in collisions in personal vehicles is inconsistent, with a high of 1,690 collisions in 1995 and the 1998 low of 315 (Haynes & Molis, 2016). Since fireground injuries

began to be recorded officially, fireground injuries have decreased proportionally with the incidence of structural fires while injuries in other categories have continued to rise. While preventing all firefighter injuries is not a realistic goal, it appears that there is room for improvement in some areas where firefighter injuries are occurring.

The occurrence of fireground injuries remains high, with the severity ranging from minor to life-threatening. Between 2010 and 2014, there was an average of 30,000 fireground injuries annually (Campbell, 2018). The largest category of fireground injuries were strains and sprains, which accounted for over 50% of total injuries (Haynes & Molis, 2016). The leading cause of fireground injuries were falls, slips, or jumps, resulting in strains or overexertion (Haynes & Molis, 2016). Firefighter injuries to the upper extremities were the leading area of injury at 21.2%, with lower extremities following closely at 20%. Injuries to the head area accounted for 14.2% of injuries, the neck, throat, and shoulders accounted for 11.6% of injuries. Multiple body parts accounted for 7.8% of injuries, thorax, 7.1%, internal injuries accounted for 6.2% of injuries, and injuries to the spine, abdomen, pelvis, or hip area accounted for 5.6% of injuries, followed by other injuries which accounted for 1.8% of injuries. It should be recognized the category “none” comprised 4.1% of the total number of injuries.

Most of the fireground injuries to firefighters between 2012 and 2014 occurred at the fire scene at just under 96%, with 53.3% of those occurring outside the structure and 42.3% occurring inside the structure. Extinguishing the fire or neutralizing the incident activities accounted for 52% of the total fireground injuries, followed by suppression support and other incident activity at 32.5%, with the remaining activity-related injuries occurring with other related fireground activities (USFA, 2016). The percentages of where injuries occur to firefighters have remained consistent since such statistics were first published. Given that these numbers have remained

consistent since 1981, there is most likely no strategy that can impact these categories, but perhaps the incidences of occurrence can be impacted.

The fire scene is considered the immediate area where a fire is, or has been, other actions that aid in the extinguishment of fires such as water supply, may be remote from the fire scene but are still considered fireground injuries. Extinguishing the fire or neutralizing the incident activities accounted for 52% of the total fireground injuries, followed by suppression support and other incident activity at 32.5%, with the remaining activity-related injuries occurring with other related fireground activities (USFA, 2016). The percentages of where injuries occur to firefighters have remained consistent since such statistics were first published. Given that these numbers have remained consistent since 1981, there is most likely no strategy that can impact the fact that an overwhelming number of fireground injuries arise at the fire scene, and that a majority of those happen outside the structure where the fire is occurring. Injuries to firefighters happening outside the structure where the fire is or was actively being fought to make sense because all firefighters must enter and exit from outside the structure, there may be falling debris, trip hazards with hose and equipment, poor lighting, and fatigue. In many cases, firefighters are crawling inside of a structure lessening the likelihood of a slip, trip, or fall happening inside of a structure.

Injury Rates

Firefighting is one of the most dangerous professions in the country, and firefighters are more likely to suffer a severe injury than the average U.S. worker (Griffin et al., 2016). Some estimates put the rate of injury for firefighters at 4 times that of the average U.S. worker (Campbell, 2018). Other research puts the rate of firefighter injuries at over 3 times that of workers in the private sector (Orr et al., 2019). Lentz et al. (2018) put firefighter injury rates at 3 to 7 times higher than the national average. Haynes and Molis (2016) reported that in 2015 a

firefighter was injured almost every 8 minutes in the United States. Based on data provided by the NFPA, the injury rates for firefighters working at structural fires have remained consistent since 1981, at 23.3 injuries per 1,000 fires, compared to 2015 when the rate of injury per 1,000 fires was 21.6. However, the occurrence of injuries to firefighters while performing their duties did increase by 7.5% in 2015 over the previous year. Between 1981 and 2015, there were spikes in the rate of injury per 1,000 fires. The high was 28.3 in 1990, but the numbers never fell below 20.8, which was the rate in 2014. Firefighters in the northeast region of the country have the highest incidence of injury consistently since injury data began being collected in 1981 (Haynes & Molis, 2016). Despite significant changes in building construction, codes, firefighter personal protection, and training, injury rates for firefighters have remained consistent since statistics began to be tracked. Although fireground injuries have decreased overall at about the same percentage as the decrease in structural fires, the rate of occurrence remains unchanged, and in some cases, has increased.

Types of Structural Fires and Injury

Fires in residential homes make up most of the structural fires annually and are a good barometer of fire-related activity (USFA, 2019). Between 2010 and 2014, the largest number of fireground injuries occurred at residential structures. However, the largest rate of injury per 100 fires occurred at manufacturing or processing plant fires. During that time, residential fires accounted for 79% of all structural fires with manufacturing or processing plant fires accounting for only 1% of all fires. This indicates that fires at an industrial site may have a higher risk of firefighter injury, but residential structures result in a higher rate of overall injuries (Campbell, 2018). Additionally, the lower incidence of fires in commercial settings may be indicative of a higher percentage of sprinkler system coverage than in residential settings. Lower incidences of

structural fires in fully, sprinklered buildings may further the argument for residential fire sprinklers nationwide, which would directly impact firefighter injuries.

Firefighter Demographics

The USFA puts the number of active firefighters nationwide in 2019 at 1,064,600. This represents career, on-call, and volunteer firefighters from 27,179 registered fire departments in the United States. The USFA breaks down the percentages of active firefighters as 33% career, 54% as volunteers, and 12% as on-call firefighters (USFA, 2020). Most U.S. firefighters are White males, with 9.2% of firefighters being Hispanic or Latino, 8.1% African American, less than 1% being Asian, and just over 4.5% of firefighters being female (Haynes & Stein, 2017). Despite aggressive recruiting campaigns, firefighters in the United States remain predominantly White males.

According to the USFA, there are 27,179 fire departments registered in the United States, or about 88% of all fire departments nationally (USFA, 2020). While based on official data, the number of registered fire departments demonstrates that statistics may be incomplete and there are most likely more firefighters than listed by the USFA. Injuries sustained on the fireground occurred in male firefighters 95% of the time. This is consistent with the ratio of males to females in the fire service with those numbers being 96% male and 4% female. Injuries were reported in career firefighters the most between 2012 and 2014, comprising 70% of fireground injuries. The breakdown of injuries by type of firefighter, career, or volunteer, shows that volunteer firefighters between the ages of 20 and 24 have the highest incidence of injury, at just fewer than 20%. Career firefighters between the ages of 40 and 44 have the second-highest incidence of injury, at just below 19%. Career firefighters sustaining injury does not exceed 15% until the 35-39-year-old age bracket, and injury rates in volunteer firefighters do not surpass the 15% mark after the

25-29-year-old age bracket. The NFPA estimate of 68,085 injuries in 2015 may be lower than actual injuries because it is based on voluntary reporting from 2,605 fire departments. However, even though reporting is voluntary, the NFPA is still the best source for all firefighter injuries. The USFA publishes firefighter injuries annually based on reporting to the NFIRS. NFIRS data only includes injuries recorded as part of an incident report. This is significant because injuries recorded in an NFIRS report would not include injuries sustained in training, physical fitness, inspections, duties around the fire station, or other duties where an incident report is not generated thus painting an incomplete picture.

The injury breakdown by gender is like the differences between career and volunteer firefighters. Although most of the injuries occur to male firefighters, which is consistent with the higher percentage of male firefighters in the United States, female firefighters have a higher percentage of injury than their male counterparts between the ages of 15-34 years. Female firefighters above the age of 34 years sustain injuries at a lesser rate than male firefighters (USFA, 2016). Career firefighters suffered a higher rate of injury per 1,000 firefighters between 2010 and 2014 at 61.2 injuries for male career firefighters and 61.1 for female career firefighters. Male volunteer firefighters were injured at a rate of 7.4 per 1,000 firefighters, and female volunteer firefighters at a rate of 5.7 injuries per 1,000 firefighters during the same time (Campbell, 2018). Reasons for the disparity in injury rates between career and volunteer firefighters can be attributed to fire activity being much higher for career firefighters despite there being more volunteer firefighters throughout the country (Campbell, 2018). Disparities between injury rates of males versus females are hard to pinpoint and may be attributed to less accurate reporting rates among males.

The community population can also reflect the variation in injury rates. Between 1981 and 2015, communities with populations of between 500,000 and 999,000 had an injury of 5.1 per 100 firefighters. During the same period, communities of 1,000,000 people or more had an injury rate of 4.8 injuries per 100 firefighters. Communities with populations under 2,500 and 2,500 to 4,999 had injury rates of 0.8 and 1.1 injuries per 100 firefighters, respectively. The rate of injury to firefighters per 100 fires had proportionally the same ratios as injuries per 100 firefighters. It should be noted, however, that the highest incidence of injury per 100 fires and 100 firefighters occurred in communities serving populations of between 500,000 and 999,000 people, as opposed to communities with populations over 1,000,000 where the most fires occur (Haynes & Molis, 2016). Anomalies in injury rate variances by population may be due to the different staffing models in the respective communities, which may have an impact on firefighter injuries.

Injury Factors

The causes of injuries in firefighters can be attributed to multiple factors. Some of the factors may stand alone as a cause, while others may be shared causes of injuries to firefighters. Other research on firefighter injuries has identified multiple factors related to firefighter injuries or the impact of firefighter injuries, and include sleep deprivation, stress, overall fitness, and cardiovascular health, and a firefighter's protective equipment.

Sleep Deprivation

Sleep deprivation may be a major factor in injuries to workers in the United States as well as a major contributor to illness. Researcher's found an association between sleep deprivation and weight gain, heart diseases, Type II diabetes, as well as an increase in accidents (Kecklund & Axelsson, 2016). The average amount of sleep an adult in the United States gets per night has dropped significantly in the last 100-plus years. Insufficient sleep can adversely impact decision-

making, and leadership skills, hurting productivity and impacting the health of sleep-deprived workers (Nowack, 2017). Kaipust et al. (2019) posited that a lack of sleep contributed to injuries in firefighters, and in other occupations. Their research found a high association of sleep disturbances and depression symptoms in study participants, and they recommend further study on the topic. A more recent study found that sleep disturbances in firefighters did increase the likelihood of injury based on a reduction of cognitive functions (Stout et al., 2020). Career firefighters in the United States typically do not work a traditional schedule. A career firefighter's typical work schedule involves two or more 24-hour shifts per week, or a rotating schedule of 10-hour days, followed by two 14-hour nights. Volunteer firefighters typically have no work schedule regarding their firefighting activity and have their sleep patterns voluntarily interrupted by responding to emergencies as they arise. It is recommended that people sleep between 7 and 9 hours per night including uninterrupted cycles of sleep. Based on the shift's firefighters' work, and the interruptions experienced due to the nature of their, firefighters' normal sleep patterns are disturbed (Billings & Focht, 2017). Sleep patterns, or circadian rhythms as they are called, can become out of sync with extended work hours, irregular shifts over a period. Interrupted sleep patterns can lead to chronic sleepiness which in turn can lead to fatigue, burnout, and injuries as well as contribute to heart disease (Sullivan et al., 2017).

The research by Stout et al. (2020) found that sleep disruption in career firefighters working common shifts of 24 hours on followed by 48 hours off, found that even with minimal disruptions to firefighters' sleep patterns were negatively impacted. Negatively impacted sleep patterns lead to decreased cognitive abilities, which can lead to injuries (Stout et al., 2020). Kaipust et al. (2019) researched the association between sleep deprivation and obesity in firefighters. Their research was conducted on 478 firefighters from the mid-west, while they recommend more research in this area; they concluded that firefighters considered obese had

double the chance of sustaining an injury while on-duty. They also defined a cyclical phenomenon where a lack of sleep contributes to obesity, and obesity contributes to sleep disorders (Kaipust et al., 2019).

The events and horrific scenes firefighters are exposed to can create post traumatic stress (PTSD) either from a singular event or as a cumulative effect from multiple incidences. The impact of PTSD and subsequent mental illness has a direct impact on sleep deprivation (Pelham, 2016). Because of the nature of their work and work schedule, firefighters are at a greater risk of developing a psychological disorder during their careers. Research conducted by Schiller et al. (2017) suggests lowering the average hours a person works by 25% would decrease stress and improve the quality of sleep workers receive during the workweek. Reducing the number of hours firefighters work may be a strategy some organizations can implement. Comprehensive changes in firefighter work schedules may decrease the impact of sleep deprivation but may not be feasible from a monetary standpoint and may be met with resistance from firefighters and their respective labor groups.

Stress and Post traumatic Stress

There is evidence that suggests repeated exposures from horrific events for first responders, including firefighters, increase the possibility of those individuals developing post traumatic stress, which can develop into post-traumatic stress disorder (PTSD), and other mental health disorders (Jones, 2017). Research has shown increased use of alcohol as a coping mechanism for firefighters suffering from the effects of PTSD (Martin et al., 2017). Research indicates there is a direct correlation between PTSD-related symptoms and burnout to work-related injuries. Such work-related injuries may be caused by the stress that results from symptoms of PTSD (Katsavouni et al., 2016). Burnout has been associated with errors, weariness,

diminished use of safety procedures in some occupations, as well fatigue, injury, and PTSD in firefighters (Smith, DeJoy, et al., 2019). The stressors firefighters encounter in the course of their duties has been proven to impact their physical and psychological health and does contribute to PTSD (Straud et al., 2018), and studies indicate a higher incidence of suicide and suicidal thoughts among firefighters suffering from the symptoms of PTSD (Boffa, Stanley, Hom, Norr, Joiner, & Schmidt 2017). An increase in suicidal ideation by firefighters has been demonstrated to coincide with increased levels of PTSD (Martin et al., 2017). PTSD in firefighters can cumulative and be related to the amount of stressful situation firefighters are exposed to in a period or a career (Gulliver et al., 2021). Research demonstrates that fire and emergency medical service personnel have a higher-than-normal rate of suicidal ideation (Martin et al., 2017). Research has demonstrated that mental illness, including PTSD is more common in first responders than in the general public, and can lead to suicidal ideation (Heyman et al., 2018). Repeated traumatic exposures are expected to create some level of stress in first responders, including firefighters, and in some cases, first responders can develop resilience to such traumatic events. The ability to develop resiliency among first responders is impacted by underlying conditions that include anxiety, depression, sleep deprivation, and the individual themselves (Straud et al., 2018). Milligan-Saville et al. (2017) discovered a link between PTSD and other physical ailments, including cardiorespiratory, musculoskeletal, and other more general conditions. The link between mental disorders such as PTSD and other chronic ailments certainly demonstrates an impact on firefighter line of duty injuries. While PTSD is being recognized as causing harm to firefighters and other first responders, there is still a lot of work to be done to lessen any impact it has on firefighter injuries. Like cancer, PTSD in the fire service is worthy of further research as a stand-alone topic.

Obesity and Cardiovascular Disease

The rate of obesity worldwide has more than doubled in the past 40 plus years (Lohmann et al., 2016). In the United States, it is estimated that the percentage of adult obesity ranges from approximately 35-40% (Flegal et al., 2016). The trend of obesity does not seem to be declining in our society, but rather increasing (Porto et al., 2016). The U.S. fire service mirrors the high prevalence of obesity and may have even higher percentages (Choi et al., 2016). On average, better than one third of all career firefighters in the United States today, who are charged with protecting the lives and property of the citizens in their respective communities, meet the definition of being obese. Estimates put the number of career firefighters as being overweight at between 73 and 88% in the United States today. Obesity has been linked to a high incidence of musculoskeletal injuries in the low back, or injuries involving lifting or straining. Sprains and strains are the most common injuries among firefighters. Obesity can increase the risk of a firefighter making a worker's compensation claim by as much as 300% and claiming a disability by as much a 5% (Jahnke et al., 2017).

Obesity is a contributor to poor overall health. In addition to cardiovascular disease, obesity contributes to hypertension, arthritis, diabetes, and even some types of cancer. Obesity has been on the rise over the last 30 years, and male firefighters are in the top three groups by occupation with a high prevalence of obesity (Choi et al., 2016). Research by Choi et al. (2016) suggests that the obesity rates of firefighters have a direct correlation to firefighters working a 24-hour shift. Obesity has been defined as having a body-mass index of greater than 30 mg/m^2, and a body fat percentage of greater than 30%. There have been concerns that the use of BMI is not necessarily an accurate description of the fitness level, particularly in firefighters, in part because of muscle mass. A study conducted on a large group of military firefighters did not support the

theory that BMI is an inaccurate measure of the fitness level of firefighters (Porto et al., 2016). Although firefighters in some cases may be more muscular than the average public, the evidence does not support the belief that BMI is inaccurate because of increased muscle mass.

There are many contributing factors to coronary heart disease, which in turn can cause sudden cardiac death when additional variables such as exertion are added to an already labor-intensive environment. Smith (2016) studied sudden cardiac death among firefighters and concluded a high percentage occurred in firefighters with underlying cardiovascular disease. Cardiovascular risk factors for firefighters include hypertension, high cholesterol, tobacco use, fitness levels, and being overweight or obese (Smith, 2016). Obesity in the fire service is trending upward and is estimated to be ranked third by occupation among male firefighters (Choi et al., 2016). Some estimates put the percentage of U.S. firefighters who are overweight at over 70%, and those who are obese at greater than 30% (Jahnke et al., 2017). Hypo-hydration, or lack of proper hydration, has also been linked to obesity. Suminski et al. (2019) found that firefighters in a state of hypo-hydration were more likely to be considered obese, although it is not clear if hypo hydration contributes to obesity. Hypo hydration may also contribute to overheating on the fireground, particularly in firefighters wearing personal protective clothing.

In any given year, the largest single cause of line of duty deaths to firefighters in the United States is caused by sudden cardiac death or cardiac-related events (Smith, DeBlois, et al., 2016; Smith, Haller, et al., 2019). Firefighting often requires action almost immediately, sometimes only minutes from a dead sleep. During fire suppression activities, firefighter heartbeats have been recorded as high as 188 beats per minute. Most instances of cardiac events and sudden cardiac death occur during fire suppression activities, but unlike other types of injury, cardiac events can occur hours after suppression activities have taken place (Wimberly, 2016).

Research has demonstrated firefighting continues to impact the cardiovascular system for hours after activities have been completed (Smith, 2016). Although the number of firefighter deaths from cardiac events has dipped annually, the percentages have stayed the same, making the drop consistent with the overall decrease in line of duty deaths (Smith, DeBlois, et al., 2016). In addition to the firefighting activities increasing stress on the cardiovascular system, there is a high level of cardiovascular diseases among firefighters due to fitness levels, lack of physical fitness, and in some cases, smoking (Smith, 2016).

One study found a correlation between BMI, firefighter age, and the risk of cardiovascular diseases. The same study also opined that the majority of firefighters are overweight and the potential for cardiac related events increases with obesity, particularly as firefighters' age (Bode et al., 2021). Obesity is considered a major risk factor in cardiac enlargement (Korre et al., 2016). Research indicates that cardiac enlargement among firefighters increases the likelihood of a cardiac event fatal or otherwise. Obesity impacts many aspects of health, and the statistics put firefighter obesity rates on par with the general public.

Research has demonstrated that improved fitness levels in firefighters, including increased aerobic capacity, will improve firefighter capabilities while lessening the potential for and severity of injuries (Nazari et al., 2018). This phenomenon has an impact on individual firefighters, their families, their coworkers, their organizations, and the communities they serve. The nature of firefighting activities is such that muscular strength, endurance, and cardiorespiratory fitness are essential for performance (Stanek et al., 2017). Unlike many occupations, firefighters need strength and aerobic endurance when working at structural fires, and this is sometimes required within minutes of an emergency notification. Despite the correlation between firefighter line of duty deaths, coronary heart disease, obesity, and high rates

of obesity among U.S. firefighters, there is no nationally enforced fitness or physical ability standard in the fire service.

Despite evidence that physical fitness and approaches such as high-intensity training contribute to firefighter health and fitness lessening the impact of injury a high percentage of firefighters remain overweight (Hollerbach et al., 2019). Wellness programs covering more than 50 million workers are in place, and the cost of those programs is considered part of the money spent on the problem of injuries in the U.S. workplace (Jones et al., 2019). Some businesses have implemented wellness programs believing fit employees can increase organizational efficiency. Wellness programs are in the best interests of both the organization and employee and research suggests a commitment from both groups does reduce costs associated with health (Ajunwa et al., 2016). Gubler et al. (2016) posited that 90% of companies that have instituted wellness programs do so intending to improve the health of their employees. With overweight and obesity rates estimated to be as high as 80%, it appears too few firefighters are actively engaged in meaningful physical fitness programs (Hollerbach et al., 2019). The fitness levels of firefighters are considered inadequate for the work they are required to do as part of their normal duties despite efforts to implement fitness standards. O'Keefe et al. (2016) studied obesity as part of an overall health predictor in a group of municipal workers, including firefighters, and found that firefighters, although the lowest within the municipal sample group, had a mean BMI of 30.34, above the threshold used to determine obesity. Not only has obesity been tied to cardiovascular disease, but it also strongly correlates with diabetes (O'Keefe et al., 2016). The NFPA has developed consensus standards for firefighter fitness based on annual physicals and a specific wellness approach guided by a physician. Despite consensus standards such as those developed by the NFPA, there is no mandatory standard for firefighters to meet or maintain annually to ensure adequate fitness levels.

PPE

Much of the research on past firefighter injuries has focused on (PPE) as a measure to reduce firefighter injuries. Although many injuries have been attributed to not wearing or improperly wearing PPE, very little research has been conducted on the impact of wearing the PPE itself, and how that impacts injuries (Petrucci et al., 2016). The leading type of injury to U.S. firefighters is strains and sprains, and many of the occurrences of these injuries can be attributed to one's balance and gait. Slips, trips, and falls can be the result of multiple actors such as fitness levels, terrain, and experience. The configuration and size of firefighter self-contained breathing apparatus can also have an impact (Kesler et al., 2018). A firefighter's personal protective equipment and self-contained breathing apparatus can weigh up to 55 pounds (Orr et al., 2019). In addition to the PPE and self-contained breathing apparatus, firefighters typically carry tools or drag hoselines increasing the weight they are carrying in addition to their body weight.

Structural firefighting boots have been designed to protect firefighters from thermal stresses and objects that may fall on or penetrate a boot; however, the features that offer those protections also restrict ankle movement. Restrictions of the ankle have been found to contribute to injuries to the lower back and lower limbs (Vu et al., 2017). The depth perception of firefighters in personal protective clothing also impacts gait, balance, and the ability to navigate obstacles on the fireground (Petrucci et al., 2016). In replicated conditions designed to simulate a firefighter's surroundings on a fireground, research has shown that the personal protective equipment negatively impacted a firefighter's ability to judge conditions properly. Research indicates firefighter's perceptions were affected to the point where they under or overestimated distances or their ability to navigate under, over, or around obstacles (Petrucci et al., 2016). Experienced firefighters were found to be more adversely affected by the perceptions of their

surroundings. This phenomenon may be based on the complacency of the more experienced firefighters, however. The outer shell of a firefighter's protective clothing is designed to limit thermal exposures, and laboratory tests have revealed the thickness of the garment can increase protection from thermal burns when in contact with hot surfaces (Mandal & Song, 2018). The work by Kesler et al. (2018) has demonstrated that personal protective equipment designed to protect can adversely impact the incidence of slips, trips, and falls, which can ultimately lead to injuries. Firefighter's wearing personal protective clothing such as coats, pants, boots, gloves, and helmets, are more likely to suffer a soft tissue injury resulting from poor posture or unnatural gait. The increased weight of the clothing and the restricted range of motion associated with wearing it also affect a firefighter's gait. The effect of PPE on the gait of firefighters can be seen through the measurement of the knee and trunk postures of firefighters during simulated firefighting activities (Sinden et al., 2016). The added weight and configuration of PPE on firefighter fatigue and gait may be further exacerbated by the addition of a self-contained breathing apparatus, which is part of an overall PPE ensemble (Kesler et al., 2018).

Firefighters wearing PPE designed to protect them from the hazards they will face in hostile environments can impair the perceptions of their abilities during fireground events, which can lead to injury (Petrucci et al., 2016). Firefighters wearing PPE on the fireground are not only required to move but to climb and pick things up. The PPE a firefighter wears during fireground operations may affect the way the firefighter picks up heavy objects with their improper posture, possibly being a contributor to injury (Sinden et al., 2016). Firefighter PPE is designed to protect firefighters in many different types of environments, most notably high heat environments, but research shows it can contribute to injuries on the fireground as well, although no research demonstrates to what degree. The limitations of the PPE insofar as weight and impact on gait,

coupled with the high number of overweight and even obese firefighters increases the possibility of the affected gait causing injury on the fireground.

Impact of Firefighter Injuries

The severity of injuries to firefighters annually ranges dramatically. Between 2012 and 2014, the largest percentage of the firefighter injuries were serious fireground injuries resulting in 41% of lost time. Moderate injuries, followed by 33% of the injuries resulting in treatment by a physician with no lost time, 22.9% resulted in first aid with no lost time, and 2.3% suffering a severe injury with lost time, rounded out life-threatening injuries with lost time at .5% (USFA, 2016). These numbers are consistent from year to year. Orr et al. (2019) cited research that found firefighters not only sustain injuries at a higher rate but took twice as long to return to work as private sector employees.

Cardiac Impact

As noted previously, almost half of all line of duty deaths annually can be attributed to sudden cardiac death from cardiovascular disease (Korre et al., 2016). The phenomenon of cardiac-related line of duty deaths is not a new one; since 1995 almost half of the annual line of duty deaths can be traced to coronary heart disease leading to sudden cardiac death (Patterson, Smith, & Hostler, 2016). The data on cardiac events draws a direct correlation between sudden cardiac death and coronary heart disease in firefighter line of duty deaths. Firefighting adds significant stress to the cardiovascular system resulting in sudden cardiac death. Sudden cardiac death accounts for over 40% of firefighter line of duty deaths (Smith, 2016). Cardiac issues have a large impact on the firefighting profession as it remains the highest percentage of the line of duty deaths annually. Despite cardiac issues being correlated to obesity and remaining the highest

cause of line of duty death, a great number of firefighters in the United States remain overweight, and many fire departments are not addressing the issue of firefighter fitness.

In addition to the high annual percentage of cardiac-related deaths of firefighters, it is estimated there are 17 non fatal events for each fatal event (Wimberly, 2016). Cardiac events in firefighters may result in a considerable amount of lost work time, placing an emotional strain on the injured firefighter and a financial strain on their organization. There are multiple cardiac stressors involved in firefighting, chief among them being the physical nature of the work. Firefighters working at structural fires have the added weight of protective clothing, and in many cases, extra body weight, and are required to perform tasks with tools such as axes and ladders. The environment firefighters work in can be considered immediately dangerous to life or health for a variety of reasons, such as the products of combustion and high levels of heat (Smith, Eldridge, et al., 2016). Exposure to smoke and gases such as carbon monoxide contributes to the dangerous environment where cardiac events in firefighters occur. Stress and overexertion elevate the heart rate, leading to many cardiac events among firefighters. However, many underlying factors contribute to pre event cardiovascular disease. A high rate of overweight and obesity in the fire service in indirectly related to cardio-vascular disease, along with direct impacts such as high cholesterol levels, hypertension and other risk factors (Bode et al., 2021). Unnecessary body weight can contribute to added physical stress on the body of a firefighter, particular when engaged in firefighting activities (Morris & Chander, 2018). One study conducted in Colorado in 2017 demonstrated that as many as 10% of firefighters studied had insufficient cardiorespiratory fitness for firefighting activities (Li et al., 2017). Although the annual line of duty deaths of firefighters has dropped since 1981, the percentage of those deaths being associated with cardiovascular events remains consistent.

Financial Impact

The cost of injuries to workers annually in the United States is estimated to be $250 billion. Other research puts the total estimated cost of prevention and injuries in the fire service at between $2.8 and $7.8 billion annually (National Institute for Standards and Technology, 2005). More recent research puts the estimated annual cost of firefighter injuries at $5.8 billion. This estimate is based on the overall estimate of injuries using multiple databases, and the estimated cost of specific injury types. Factors such as direct and indirect costs are considered as values placed on the impact on the quality of life (Butry et al., 2019). Direct costs have been defined as medical costs resulting from injuries, administrative costs, indemnity costs, among others (Butry et al., 2019). Indirect costs of firefighter injuries would include the cost of backfilling with another firefighter when an opening is created from injury, lost wages, lost fringe benefits as well as lost productivity (Butry et al., 2019). There may also be lost-time injury claims to reclaim compensation during an injury leave, and no lost time injury claims. Butry et al. (2019) estimated direct costs to be about $670 million, with indirect costs estimated at over $770 million, including firefighter related deaths. Orr et al. (2019) pointed to research that found the cost of a musculoskeletal injury to a firefighter could result in over $57,000 in medical bills alone.

Injuries to firefighters may result in a tremendous financial burden to the injured firefighter's fire department or municipality. The total financial burden of firefighter injuries in the United States is estimated to be in the billions of dollars annually (Butry et al., 2019). Another factor can be the possible perception that the injured firefighter or the community they serve is not diligent in returning the injured firefighter to full duty, if at all. Another issue outside of the financial considerations is human suffering the injury victim and their families may suffer. An injury can also be traumatic to the victim’s family as well as their department. Cardiac events

often require the victim to rehabilitate away from work, creating a financial burden for the employer (Smith, DeJoy, et al., 2016). In many cases, firefighters may have their quality of life altered for a temporary period, or the rest of their life (Michael, 2016). Firefighter injuries have a tremendous impact on an injured firefighters' organization, their family, and of course, the injured firefighter themselves.

Firefighter Attitudes and Behavior

The attitudes and behavior of firefighters can have an impact on their safety and risk of injury. Research suggests that if a firefighter feels he or she is properly prepared and well-informed about the dangers of firefighting, they may be lackadaisical about the risks. This extends to their cardiovascular disease awareness, as many firefighters do not relate it to their fitness levels. This attitude persists despite evidence that the intensity of exercise or work impacts a firefighter transition to resting heart rates (Ebersole et al., 2020). Attitudes and behaviors regarding firefighter injuries and the underlying causes further illustrate the need for a transformational leadership approach to developing strategies to address the problem.

One research study involving firefighters across 12 fire departments examined reasons why firefighters chose not to wear all of their protective equipment. As noted, the most hazardous duties the typical municipal firefighter faces are those involved in fighting structural fires. Personal protective equipment designed for structural firefighting protects firefighters from heat produced from the fire as well as hand and foot wounds from glass or sharp objects. Research conducted by Maglio et al. (2016) found that firefighters do not always wear all the components of their protective clothing during high-risk operations. During interviews, firefighters explained the inconsistent use of personal protective equipment is due to peer pressures, goal fixation, and social pressures based on how they feel they should view themselves. Some poor behavior

wearing personal protective equipment was the result of the varying ages or generations, and in some cases, newer or younger firefighters emulated older firefighters who spent much of their career without as much or inadequate PPE. The same attitudes carried over to the decontamination of their PPE. Attitudes impacting the compliance of wearing and cleaning PPE persist despite required training support by both management and the labor group representing the firefighters (Maglio et al., 2016). Goal fixation as a reason for PPE noncompliance stems from the belief that items meant to protect firefighters can hinder their requisite performing tasks promptly. With the previously discussed limitations of PPE due to weight and impact on gait, it is easy to see a correlation between goal fixation and the perception that PPE can hinder goal attainment.

Adherence to fireground decontamination is seen as an important protection against carcinogen contamination that can lead to cancer, firefighters have as much as a 14% higher risk of developing cancer than non-firefighters (Harrison et al., 2018). Fireground decontamination involves brushing off or rinsing off as many potential carcinogens in debris left as a by-product of fire. Despite firefighters being aware of the potential reduction in cancer rates through fireground decontamination, research revealed that the extent of decontamination among one group of firefighters was limited to a personal shower after the fire (Harrison, Muhamed, et al., 2017). The research by Harrison, Muhamed, et al. (2017) examined the practice of firefighter decontamination was based on self-reporting rates of firefighter efforts and attitudes toward the practice of decontamination. Firefighters overall had a positive attitude toward clean gear, but the practice of decontamination was still low despite knowledge of cancer rates in the fire service. Attitudes toward cancer among firefighters were indifferent, as it was viewed as being inevitable despite knowledge of contributing factors (Anderson et al., 2017) which may contribute to the low rates of fireground decontamination. Cancer in the fire service is a topic worthy of specific

research, and as such is not a focus of my research. However, the behavior described in both fireground decontamination and PPE noncompliance research indicates that the attitudes and behaviors of firefighters are not always in their own best interests.

Possible Injury Reduction Strategies

Firefighting is a dangerous profession, and there too many factors contributing to firefighter injuries to assume that strategies can be implemented to eliminate all injuries. The complete elimination of firefighter injuries may not be feasible, but some strategies can be implemented to reduce the number of injuries to firefighters annually and reduce the impact of those injuries. Following a consensus standard for firefighter fitness evaluations such as NFPA 1582 can help identify underlying problems that may result in injury. NFPA 1582 is a consensus standard written by experts from multiple disciplines related to firefighter injuries and deaths. There are multiple chapters to NFPA 1582 outlining an overall wellness program for firefighters, including guidelines for physicians to find underlying problems, particularly those leading to cardiovascular events or disease (Bhojani et al., 2018). Preventing injuries is the most proactive means of reducing firefighter injuries. Sudden cardiac death is the leading cause of line of duty deaths and can occur in activities related to the body's sympathetic response, otherwise known as the fight or flight response. The fight or flight response can be triggered in activities such as those on the fireground as it is a combination of susceptibility and a triggering event. The susceptibility factor is related to an individual's physical condition. Research suggests that it is rare to see sudden cardiac death in fit public safety workers (Kales & Smith, 2017). By improving fitness levels in firefighters, it is possible to remove one of the triggers to sudden cardiac death. The fire triangle is heat, fuel, and oxygen. Fires are extinguished by eliminating one of the three legs of the fire triangle. If sudden cardiac death is viewed similarly, the fire service should strive to

remove one of the triggers, and fitness is the only controllable trigger. Developing and implementing strategies to reduce cardiac death and related cardiac issues will require a transformational approach aimed at overall behavioral change.

Improving Firefighter Fitness

Fire service involves downtime conditions on shifts, where firefighters could be relaxing or even sleeping when an active call comes in, making it necessary for them to be operating at 100% within five minutes or less. The type of work a firefighter needs to perform requires a high level of muscular endurance, aerobic capacity, and muscle strength, and high cardiorespiratory fitness (Stanek et al., 2017).

Strong evidence has been presented, linking the high prevalence and cost of firefighter injuries to an overall lack of firefighter fitness. High fitness levels of firefighters will not eliminate injuries, but research demonstrates there is an encouraging correlation between improved firefighter fitness and reduced firefighter injuries (Griffin et al., 2016). There is also evidence demonstrating physical activity among firefighters may lead to fitness improvements creating a healthier overall firefighter. It is recommended that increased physical activity in firefighters be done in conjunction with NFPA recommendations related to health and safety (Sell et al., 2018).

Musculoskeletal injuries are high in the American workforce in industries where physical exertion is required as a regular part of the workday. For example, in the construction field industry, injuries to tendons, joints, and nerves are among the most prevalent. Research suggests that stretch and flex programs that aim to increase flexibility can reduce these types of injuries with the increased benefit of heightened alertness and focus (Choi et al., 2017). Most firefighter injuries in both fireground and non fireground activities are musculoskeletal injuries such as

sprains and strains (McGinnis & Games, 2017). A stretch and flex program, as outlined by Choi et al. (2017) may directly reduce injuries to firefighters in both fireground and non fireground activities. Although the work done by Choi et al. (2017) was directly related to the construction industry, it demonstrated that musculoskeletal injuries could be reduced. The research also indicated that there was not widespread acceptance in the construction industry to implement such programs. If the same attitude prevails in the fire service, there will be a need for strong leadership to implement programs such as stretch and flex. However, the injury reduction will validate these programs by reducing both the fiscal and human suffering impact injuries can have.

Further research indicates that there is a direct correlation between obesity and musculoskeletal injuries among firefighters. Obese firefighters are more than 5 times more likely to suffer a musculoskeletal injury, and the number of overweight and obese firefighters is estimated to be as high as 80%. While the general public runs a risk of increased health effects due to obesity, the risks of firefighters getting injured to the point of making a worker's compensation claim are as much as 300% higher than if they are fit (Jahnke et al., 2017). A study conducted by Jerome et al. (2020) demonstrated success in a weight reduction program tailored specifically for first responders.

Firefighting activities require both strength and aerobic capacity, and studies have demonstrated that firefighters need more aerobic capacity than the average person (Hunter et al., 2017). While not the only factor in obesity, exercise will help bring the percentage down. High-intensity functional training (HIFT) for firefighters is an approach based on functional movement and incorporating multiple movements in sequence to mimic actual working conditions for brief periods (Poudevigne et al., 2021). Poudevigne et al. (2021) explored whether HIFT contributed to increased fitness and resting heartrate significantly decreases and strength and overall fitness

increases with a 10-week program. Recently there has been a push in the fire service based on research results to promote the concepts of functional fitness and HIFT for firefighters, mainly recruit firefighters to keep them fit throughout their careers. Developing a fitness-related mindset that will be sustained throughout a career in recruit firefighters will have a positive impact on decreasing the rate of firefighter injuries. But developing fitness-related mindsets in firefighters already on the job will be the real challenge for fire service leaders.

Research by Day et al. (2019) demonstrated success using online nutrition and fitness applications for volunteer firefighters. Firefighters who participated saw weight loss and recommended the program to help motivate other firefighters.

Implementing Behavioral Change

Research indicates that behavioral changes as they apply to safety and working practices can be and are influenced by supervisors. Smith, DeJoy et al. (2020) studied safety specific transformational leadership. Their research posited that there was a direct correlation between safety specific transformational leadership and firefighters properly wearing safety equipment. As it relates to firefighters, Smith et al. (2016) confirmed that transformational leadership as it applies to safety has an impact on firefighter safety. This correlates to research from others that demonstrate the impact leadership can have on subordinate employees regarding safety. The fire service is considered paramilitary and has a leadership hierarchy. Leaders can be trained to recognize safety-related issues and how to develop strategies to reduce injuries and, ultimately, their impact on an organization (Gravina et al., 2017). Research conducted by Poplin et al. (2018) demonstrated cost savings with worker's compensation claims when a proactive safety risk program was implemented, although injury claims did not decrease. Most fire service leaders started as entry-level firefighters and are accustomed to training, and more importantly, are

familiar with fire service injuries. Because most fire service leaders understand the injury problem in their industry and the potential effects on the community, if properly trained in reduction strategies, they should be able to influence the rank and file to transform behavior. This supports the notion that transformational leadership can have a profound impact on the problem of firefighter injuries.

Transition

In Section 1, I provided an overview of the high rate of injuries sustained by firefighters annually and the economic impact of those injuries. I also detailed overall firefighter fitness levels being poor and, and the problem that presents based on the nature of the work firefighters perform. I further demonstrated that poor fitness levels in firefighters were shown to contribute to the nature of the injury's firefighters suffer including cardiac-related events. In Section 2, I outlined the process for performing a qualitative case study research project. I also outlined the methodology used in developing my research project, how data would be analyzed, as well as demonstrating validity, reliability, and an ethical approach to my research, and demonstrated how my case study participants were chosen, data collection methods, and the role of the researcher for my project. In Section 3, I was seeking to answer the research question by interviewing my case study participants using open-ended research questions during semistructured interviews. I also analyzed all data collected, develop conclusions, and made recommendations based on answering my research question.

Section 2: The Project

In Section 2, I outline the process of how the research study was constructed, including the purpose of the study. I also discuss the factors necessary to constructing a proper qualitative study and explain why these procedures are necessary, including the role of the researcher, study participants, the research method and design, data collection instruments and techniques, data organization techniques, data analysis, and study validity.

Purpose Statement

The purpose of this qualitative, multiple case study was to explore strategies that fire service leaders use to minimize firefighter injuries. The targeted population consisted of fire service leaders from 5 organizations in New Hampshire and Massachusetts who have implemented injury prevention measures. This population was appropriate because these organizations have implemented risk management programs aimed at reducing firefighter injuries in their organizations. Pollack et al. (2017) posited that the implementation of risk management programs can have a positive impact on the injury-causing behavior of firefighters. The implications for social change stem from decreasing injuries to firefighters, thereby reducing human suffering and the negative economic impact to fire departments and, ultimately, taxpayers.

Role of the Researcher

Qualitative research emphasizes the exploration of the shared experiences of a group (Almalki, 2016). I have similar experiences with study participants on an industry-wide level, having been a firefighter for over 33 years. I have worked for multiple municipalities in both New Hampshire and Massachusetts and have served in multiple roles during that time. As a fire service professional, I am familiar with the impact firefighter injuries can have on individuals, their

organization, the municipality they serve, and their families. The term reflexivity has been used to recognize the position of a researcher and provide them with an awareness of their own unconscious bias and perception as a researcher (Mason-Bish, 2019). Berger (2015) recognized three different roles a researcher can assume during their research project as it relates to their participants: (a) sharing experiences of participants, (b) moving from an outsider to an insider during the research, and (c) the researcher has no experience in the area they are researching. As a researcher with similar experiences to the study population, it was critical for me to remain objective and not look at interview responses through the lens of my experiences to help ensure validity. Researchers remaining objective during the research is important to adding validity to results (Berger, 2015). I accomplished this by remaining objective and ensuring the research question remained the focus of the study.

The goal of qualitative research is to produce a valid study that has value in helping to solve a problem. Triangulation is one way to ensure the validity of a research study, and interviews are one method of achieving triangulation (Fusch et al., 2018). I collected data through interviews with five fire service leaders in New Hampshire and Massachusetts who have the authority to implement strategies aimed at reducing injuries to firefighters that will ultimately lessen fiscal impacts. Interviews were conducted keeping the ethical considerations outlined in *The Belmont Report* (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1979) in mind, specifically respect for persons, beneficence, and justice. Respect for persons considers that people should be treated as autonomous, and those people with diminished autonomy are entitled to protection, while beneficence ensures people are treated ethically, and justice confirms people are treated fairly (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1979).

As the researcher, I developed an interview protocol (see Appendix B) that was followed with each case study participant. I used a semistructured interview process that took place in person or over virtual platforms, such as Zoom, or Microsoft Teams. The choice of which platform to use was left to the participants. This allowed participants to feel they were safe during the current COVID-19 pandemic. Interviews using technology such as Skype or Zoom can provide flexibility for the researcher and participant as well as provide for a more unprompted and personal interview (Heath et al., 2018). During the interviews, I asked open-ended questions aimed at reaching data saturation. In addition to the interview allowing for flexibility and follow-up questions, it may provide a setting where the participants may offer more information than other circumstances might allow for.

I used member checking as a tool to limit or prevent researcher bias when analyzing results. Member checking is a process whereby study participants are given the opportunity to provide feedback based on their responses, which are either validated or further explained to provide validity to a study (Birt et al., 2016). Recognizing potential bias by the researcher because of the shared experiences of the study participants is a reflexive approach (Bulpitt & Martin, 2017). As the data collector for this study, I recognized the potential for bias and incorporated strategies to limit it, such as employing member checking.

Participants

Choosing participants who understand the full impact of firefighter injuries was paramount to my research. Purposeful sampling involves choosing participants who will be relevant to the research and will provide meaningful data to the results (Luciani et al., 2019). The participants for my multiple case study were 5 fire service leaders from New Hampshire and Massachusetts with the authority to implement strategies aimed at reducing firefighter injuries

and the impact of said injuries. The participants were all fire chiefs of their respective organizations. Fire service leaders are well versed in the attitudes and experiences shared by firefighters, so I expected their interview responses to provide insight into the impact of injury reduction strategies. Case studies represent a larger population of the same case being studied (Elman et al., 2016). This study involved participants who represented entire organizations, as suggested by Elman et al. (2016), and to assist in assuring data saturation was reached. Because of my association with the fire service, gaining access to willing participants was not an issue. I had to, however, continue working to ensure the participants' confidentiality and that their answers were kept confidential. Ensuring the confidentiality of participants helped make sure that the participants answered interview questions truthfully, adding to the validity of the study.

Research Method and Design

In the following subsection, I discuss the method of exploration and the design used in this study.

Research Method

I used a qualitative method to explore the overarching research question of what strategies some fire service leaders are using to reduce firefighter injuries. The qualitative methodology is used by researchers to explore and understand the overall experiences and attitudes of a participant or a case and deliver subjective results that are descriptive in trying to understand a phenomenon (Farghaly, 2018). Researchers strive to produce unbiased outcomes to their research to the degree possible.

I used the qualitative methodology to answer open-ended questions and collect data directly from the members of the fire service through interviews. Participants being interviewed

for this study were considered case studies. Researchers use the qualitative approach to describe interactions, formulate theories, and describe the experiences of a group of participants (Smith, 2017). I used the collected data to understand successful strategies used to minimize injuries to firefighters. Qualitative research does not involve data created from a lab or experiment but rather an investigative approach targeting a group of participants (Smith, 2017). Because my research study focused on the experiences of the case studies, the qualitative methodology was appropriate.

Researchers conduct quantitative research when statistics are collected as numerical data and objective results are the goal. Researchers can also use quantitative research where random sampling may be a tool used to establish correlations between variables using a descriptive approach (Farghaly, 2018). Researchers use the quantitative methodology to answer precise questions based on a limited data set. For these reasons, a quantitative methodology was not appropriate for the current study. Researchers using the mixed-method approach combine both qualitative and quantitative approaches to produce their work (Maxwell, 2016). I did not use a quantitative method; therefore, a mixed method approach was not appropriate for this study.

Research Design

Researchers using a qualitative method have multiple design choices for their work. I employed a multiple-case study design for this study. A case study design is used when the researcher is trying to understand how or why something may have happened or is happening in a group or field of participants (Smith, 2017). Case study methodology is used by researchers to examine the current experiences of a group (Yin, 2017). Case study research is an analysis of a group to reveal something related to the research (Mills et al., 2017).

Some other design choices within qualitative research are the ethnographic or phenomenological designs. Ethnography is the observation of behaviors or beliefs of a group and is accomplished by the researcher integrating with the group to the degree possible (Smith, 2017). The ethnographic approach may involve a researcher observing a group behavior or overall culture looking for trends or patterns (Mol et al., 2017). A phenomenological design is also used to study the human experience but can be more focused on a singular cause or phenomenon (Mol et al., 2017). A case study design is used to provide a better understanding of a situation to study similarities and differences between cases and allow the researcher to determine the validity of their findings (Gustafsson, 2017). For my research, a case was an organization dealing with the problem of firefighter injuries. My research focused on the experiences of firefighters but did not involve personal observation or did it focus on a single cause or phenomenon, which is why the case study design was most appropriate.

Researchers using case study approach should strive for internal and external validity when conducting research (Elman et al., 2016). The interview questions were open ended and were designed to determine what the impact of firefighter injuries is and what some fire service leaders are doing to reduce the incidence of injury. Determining the impact of firefighter injuries and understanding injury reduction strategies was important for accuracy in data collection and the dissemination of interview and survey answers. To maintain accuracy, limit researcher bias, and help provide for data saturation, I used member checking. Member checking is a process of providing feedback to study participants based on their responses to interview questions (Birt et al., 2016). Member checking ensured that my interpretations of what the study participants said and meant are accurate. To complete the member check process as a validation tool, I scheduled a follow-up session with each participant and reviewed a summary of their answers to the interview questions to ensure accuracy.

Asking interview questions of fire chiefs also helped define the knowledge level of the participants, in this case, as it relates to the problem of injuries to firefighters. Asking questions of senior fire officers was an essential aspect of my research because those fire service leaders needed to fully understand the problem before they could implement strategies aimed at correcting it.

Population and Sampling

Part of the qualitative research process involves ensuring data saturation has been reached. Data saturation is reached when no new or emerging topics are introduced and or the research study can be replicated (Braun & Clarke, 2021). Saunders et al. (2018) outlined four components to determining sample size in qualitative research: rules of thumb, conceptual models, numerical guidelines, and statistical formulae. Multiple factors determine how a sample size may be determined, such as saturation, pragmatic considerations, and quality of analysis (Vasileiou et al., 2018). Researchers can also choose their study participants based on the theme of their research, with the theme being a common element among participants (Sim et al., 2018). Researchers searching for common themes or patterns among case studies can use the replication approach, which involves duplicating the approach to each case study to find evidence supporting the researcher's theory (Yin, 2017).

My research study was comprised o five case studies, which were fire departments in New Hampshire and Massachusetts employing approximately 500 career firefighters. I selected participants because they were career fire department leaders and more likely to have data to help answer the research question. Additionally, all research participants had experienced injuries to their personnel at some point and must have successfully used strategies to minimize firefighter injuries, so the theme of injury reduction applied to all study participants. Lastly, this sample size

represents a large number of career fire department totals throughout both states and choosing more than five would not have been pragmatic due to geographical considerations and the ability to conduct interviews promptly; although, more participants could have been added if necessary to reach data saturation. I employed the replication approach to determine if transformational leadership does have an impact on creating strategies to reduce firefighter injuries, thus decreasing the impact of those injuries. The replication approach was appropriate to use because all the participants were in the same industry and geographical area and shared common missions.

Ethical Research

My research involved five case studies of fire departments in Massachusetts and New Hampshire. Each case involved interviewing a fire service leader from that organization. I assumed each contributor participated in the research voluntarily. Each participant signed an informed consent form before I collected data from them. The informed consent form contained a description of the parameters of the research and what I did to protect the identity of not only the organization participating as a case study, but the fire service leader acting on behalf of the organization. Participants had the opportunity to withdraw from the study at any time during the research process by notifying me as the researcher. As a fire service professional for over 33 years in both Massachusetts and New Hampshire, I was confident that a replacement participant could have been substituted for anyone wishing to withdraw.

As a researcher, I was seeking usable results from my case study research to answer my research question. I also had to consider ethics during the research process. Ethical research involves researchers looking for answers to their research questions while ensuring no harm comes to the research participants. Researchers must gain permission from their institutional review board before conducting research. I gained approval from the Walden University

Institutional Review Board (IRB) before conducting my case study research. I was assigned IRB approval number 03-22-21-0666550 with an expiration date of March 22, 2022. *The Belmont Report* outlines the protection of research subjects to ensure study participants are treated with dignity and respect and researchers follow ethical guidelines (Kowalski et al., 2017). I will always safeguard the confidentiality of my case study participants to ensure ethical standards have been met.

My research was aimed at finding strategies that fire service leaders have used in minimizing firefighter injuries. Participants received no benefit from my research but did aid in identifying injury reduction strategies from which other fire service leaders may benefit. Case study participants could also face repercussions should confidentiality not be maintained. This repercussion may come from municipal officials or a labor group making it imperative that I as the researcher protect participants' identities. All results will be kept electronically and locked up for a minimum of 5 years from the conclusion of the research. Case studies were not identified by name but rather participant identification numbers 1, 2, 4, 5, and 6, representing 5 participants. Validation involves searching for verifying the accuracy of research and involves rigorous data collection using techniques such as triangulation (Mills et al., 2017). It was assumed the participants of my case study research were truthful in answering questions that will aid in the validation of my research.

Data Collection Instruments

I was the primary data collection instrument when working with my case study participants. I developed open-ended interview questions to help answer the overarching research question. I conducted a theoretical analysis of the data provided by my case study participants. A theoretical analysis approach is used by researchers searching for commonalities or themes

among in their research (Lester et al., 2020). My research question sought to find strategies some fire service leaders are using to minimize firefighter injuries. I used a theoretical analysis approach to find common answers to the interview questions posed to my case study participants. I employed a semistructured interview technique to garner the required data to conduct a theoretical analysis.

Conducting semistructured interviews is a common method used by qualitative researchers to mine data from case study participants (Kallio et al., 2016). Qualitative research can include in-depth interviews, direct observation as part of an exploratory approach to research (Fusch et al., 2018). Direct observation will not be part of my multiple-case study, but observation of the case study participants during the interview process will be. Data collection involved case study participants answering a series of questions that I recorded and transcribed. The answers were collected and transcribed on a form as provided in Appendix B of my research study. Researchers with a background in their respective research areas may impact their study research with unconscious bias and should ensure that does not occur to ensure the validity of the research (Fusch et al., 2018)). Bias is present in qualitative research because the researcher is looking at the data from their experiences and background and researchers should understand they have a bias when conducting research. Triangulation can help mitigate bias by ensuring results are based on data mined from multiple sources (Fusch et al., 2018). I conducted a multiple-case study involving 5 participants. Data were collected from my case study participants and analyzed and coded by topic allowing for triangulation of collected data. Another way to help reduce bias is to ensure all answers are properly documented and the interviewee agrees with the answer (Yin, 2017). I recorded answers from case study participants electronically after they agreed to be recorded. I conducted follow-up interviews to ensure the accuracy of their answers to reduce any bias I may have had regarding the interview question or the participant's response.

During a multiple-case study, the researcher should be cognizant of answers provided by each participant compared to the answers provided by others. A researcher will want data from participants to be accurate and as unbiased as possible. If multiple answers to a question are similar and there is one outlier, or a participant refuses to answer the question, it may be an indication of bias on the part of the participant (Yin, 2017). During the interview process, I interviewed seven fire chiefs and settling on five participants using a set of prescribed questions. Within certain parameters, researchers expect all answers to be similar, and if they are not and no reasonable explanation as to why they are dissimilar it may be an indication of bias.

As a researcher with a background in the topic that I am researched, I used the process of member checking to guard against influencing the results garnered from my case study participants. Member checking is a process where the case study participants are asked to verify their answers after the interview process to aid in confirming the validity of the research (Fusch et al., 2018). Member checking ensures the accuracy of the case study participant's answers to the research questions to aid in the validity of a research project (Thomas, 2017a). Semistructured interviews, member checking, and data mined from case study participants will aid in ensuring construct validity (Yin, 2017). Triangulation of data occurs when there is a merging of multiple types of evidence sources like relevant organizational documents such as standard operating guidelines, general orders, memos, archived and current records, as well as participant observations to reach saturation (Yin, 2017). Data saturation occurs when no more useful information can be found on a topic (Saunders et al., 2018). The goal of my research was to explore strategies some fire service leaders are using to minimize firefighter injuries. As part of the exploration of successful strategies implemented by some fire service leaders, I conducted semistructured interviews. Interviews were either in person or using technology that allowed for an interview via Zoom or Microsoft Team. Interviews took take place in the location or means of

the participant's choice. By interviewing 5 case study participants I expected to reach data saturation, but I could have added additional participants if necessary, to reach data saturation. Research must be reliable and valid to assist in attaining the goal of reducing injuries and the impact of injuries, and member checking may add to reliable and ultimately, useful results. A case study protocol is a process for conducting case study interviews. Case study protocols should include an overview of the objectives of the case study, procedures for collecting data, questions to be asked during the interview process, and a report outline of how the researcher will present the data collected (Yin, 2017). I developed a protocol for conducting my multiple-case study interviews. My case study protocol (see Appendix B) addresses how to introduce the process to the participants including a script to be read, the procedures I used to collect the data provided, the questions that were asked, provisions for follow-up questions, observation of the participants to recognize bias in their answers, and a procedure for a follow-up interview to allow for member checking.

Data Collection Technique

I conducted semistructured interviews in which case study participants were asked a series of questions. Semistructured interviews are constructed of predetermined questions based on the researcher's desire to learn more on the topic being researched (Lester et al., 2020). I recorded the answers provided by participants digitally, with prior participant permission, and later transcribed those answers. Semistructured interviews should consist of questions based on common themes and potential follow-up questions (Kallio et al., 2016). Although each case study participant was asked identical questions, their answers varied, and some led to follow-up questions as suggested by Kallio et al. (2016) to ensure understanding and clarity. Because each case study participant has the potential to answer questions differently based on their experiences

and perspectives, follow-up questions were developed as part of the semistructured interview progresses. I ensured accuracy in the dissemination of both the research questions and the follow-up questions by recording answers digitally for transcription later. I have developed a series of questions that are designed to answer my research question through semistructured interviews with case study participants. While conducting my research, I collected data from peer-reviewed literature based on my research question of what strategies are employed by some fire service leaders to minimize firefighter injuries. There are multiple ways to collect data such as studying documents or archival records, direct observations, studying physical artifacts, or conducting interviews (Yin, 2017). I used interviews to collect my data and interviewees may have referenced documents internal to their organizations such as standard operating guidelines. The data I collected was provided by an individual but was representative of the organization that the individual represents. Yin (2017) cited multiple strengths and weaknesses of interviews. The advantage of interviews would be that they can be focused directly on what the researcher is looking for and provide for immediate follow-up questions based on initial responses to interview questions. The disadvantages are that the interviewee may be biased, lack accurate recall on a topic, and may say what they feel the interviewer wants to hear. In my multiple-case study, the interview process worked well because I was able to ask immediate follow-up questions based on the responses to my interview questions. The topic of minimizing firefighter injuries is complex and the ability to follow a path created by an interview answer may provide more depth on an issue or topic related to an interview question. While interviewee bias is a possibility, using multiple participants lessens the possibility that the data are inaccurate due to bias because multiple sources are providing feedback and one outlier may not be considered accurate. The interview process will allow me to view the participants, but only how they answer questions.

Data Organization Technique

I collected data from case study participants by recording answers digitally and each case study participant's answers were later transcribed. Original transcriptions will designate who each case study participant is by assigned a corresponding number that will be kept electronically on an external hard drive located in a secured area to ensure the names of participants and answers to questions are known to me only. Transcripts allowed me to organize data in a way it was easily accessed to help find meaningful results as suggested by Castleberry and Nolen (2018). These data will be secured for a minimum of 5 years then will be destroyed based on institutional review board protocols. I used an approach called thematic analysis to disseminate the data collected during the interview process. Thematic analysis is a process where a researcher looks for important trends in data that begin to form patterns (Braun et al., 2019). I studied data mined from case study interviews searching for patterns that begin to demonstrate strategies leaders are using to minimize firefighter injuries. All data collected will be kept in a log that correspond to transcribed interview responses for use in analysis once all data were compiled. All the data I collected were separated first by participant number, then by category or question, and were further separated by pattern. I used a research log to allow for proper disassembling of data to find out what is happening with my research and why it is happening as outlined by Castleberry and Nolen (2018). Organizing data correctly will contribute to the validity of my results allowing for meaningful use of my research.

Data Analysis

Analyzing data was a crucial component in determining the quality, reliability, validity, and ultimately usefulness of my research. To ensure my research is valid and of high quality, I employed data triangulation in conducting data analysis. Triangulation involves studying multiple

sources of data and uses multiple data collection techniques to ensure rich and reliable research (Fusch et al., 2018). My research involved case studies; by examining the experiences and perspectives of each participant based on a principal research question. Case studies provide a researcher with a better understanding of an issue they are studying based on the evidence provided by participants (Ridder, 2017). Case studies are a collection of data based on the experiences of the participants that researchers draw upon using a thematic analysis approach to analyzing data. A thematic approach looks for patterns that a researcher can interpret to draw conclusions related to their research (Castleberry & Nolen, 2018). Theoretical analysis of data involves searching for common trends or themes based on related categories (Lester et al., 2020). Case study research can help researchers to discover, describe, and assess issues by producing insights into why, what, and how of those issues. Greater insight into specific issues may lead to a better understanding of behaviors, and actions (Mills et al., 2017). The case study participants in my research are all from the same industry, fire service leaders. With all case study participants having a common profession I was able to employ analysis that incorporates parts from thematic and theoretical analysis approaches. Thematic analysis involves a researcher looking for themes during the data analysis process that can then be categorized (Roberts et al., 2019). Theoretical analysis is used when the researcher is analyzing related categories to find themes that may be based on the overall research question (Lester et al., 2020). My research involved predetermined categories such as strategies to minimize injuries, and I studied the data searching for patterns to emerge from the interview questions that could further be separated into specific categories.

Analysis requires a researcher to study all the data compiled during their research process. One method of compiling information is transcribing an interviewee's answers to interview questions (Castleberry & Nolen, 2018). My case study interview questions were each designed to elicit information on the research topic or potential strategies for successfully

addressing the research problem. During analyses of the data collected during the semistructured interviews I conducted, I used coding to identify themes that emerged after I transcribed the responses my case study participants provided. I used a simple Excel spreadsheet to separate themes or patterns that emerged for closer dissemination. Researchers should analyze all data collected in relationship to answer the overarching research question (Houghton et al., 2017). I analyzed the answers my case study participants provided using a thematic analysis approach whereby I looked for patterns among each set of answers. A thematic analysis approach is considered coding to help to determine themes that helped answer my research question. Themes or patterns that emerged from the answers given to my interview questions were broken down further into categories. For example, there may have been multiple case studies where a mandatory physical fitness program was incorporated into the daily routine of firefighters to reduce injuries relating to poor fitness levels. Instituting a mandatory fitness program may have emerged as a theme that could be further broken down as a category. If analyses of the interview questions reveal a pattern of the implementation of firefighter fitness programs emerging, and the category of physical fitness is identified, this may lead to the conclusion that mandatory fitness programs are a strategy some fire service leaders use to minimize firefighter injuries.

Reliability and Validity

Dependability

Researchers conducting qualitative research must ensure the data being put forth and ultimately make recommendations, is based on reliable information, and the research is considered trustworthy. Research being considered trustworthy requires the research to have dependability, credibility, transferability, as well as confirmability (Hayashi et al., 2019). Dependability refers to research being considered reliable or solid and is a key contributor to

qualitative research. There are multiple methods of ensuring dependability in qualitative research. My case study research involved semistructured interviews which I digitally recorded for transcription. I conducted member checking to confirm the dependability of the data I collected. Member checking consists of the researcher interview protocol to ensure accuracy and lessen the chance of bias (Fusch et al., 2018). I followed up with all of my case study participants and ensure the information I transcribed is accurate and what the participant meant while answering my interview questions is fully understood. This allowed for any inaccuracies to be corrected or for the participant to add anything they may have missed during the initial interview session. Member checking contributes to a process that is transparent because participant responses are accurate adding credibility and dependability to research. Member checking will also ensure data being compiled can be confirmed and allow an observer to determine if the research findings are transferable (Castleberry & Nolen, 2018).

Validity

Validity, as it applies to research, is better suited for quantitative studies but is important to qualitative research as well. Validity in qualitative research can refer to trustworthiness or rigor (Saunders et al., 2018). Participant validation involves the participant checking the researcher's work to ensure what has been recorded is, in fact, accurate (Smith & McGannon, 2017). Participant involvement helps ensure the researcher remains properly engaged in the member checking process, which will aid in validating the transferability of the research data. Member checking adds to ethical considerations by helping to ensure that the researcher differentiates between participant thoughts or quotes from the researcher's synthesized thoughts (Birt et al., 2016). This approach is necessary to ensure the information being put forth as research results are accurate. Hayashi et al. (2019) outlined five types of validity as it applies to research, descriptive

validity, interpretive validity, theoretical validity, validity generalization, and valuation validity. I employed a descriptive validity approach by ensuring the data I collected during interview with my case study participants was accurate.

Both validity and participant validity add to the transparency of qualitative research (Saunders et al., 2018). Transparency contributes to the trustworthiness of the research results, a key opponent to overall reliability and validity of the work (Hayashi et al., 2019).

Transferability

Transferability refers to the results of research findings applying to other situations (Cruz & Tantia, 2017). Fusch et al. (2018) posited that determining transferability should be left to the reader or future researcher. The purpose of my qualitative research study is to explore successful strategies some fire service leaders have used to reduce firefighter injuries. This is an important topic that can impact fire service leaders who are experiencing the impact firefighter injuries can have on an organization. My research results must have transferability.

Confirmability

Confirmability refers to the research results being confirmed by someone other than the researcher (Cruz & Tantia, 2017). In other words, the ability to confirm if the research results are valid is based on the work of the researcher. Ensuring research can be duplicated will help add to confirmability. Confirmability can help ensure the research results are objective (Hayashi et al., 2019). Confirmability is important and contributes to reliability and validity because it ensures the research is valid because it can be confirmed by another researcher.

Data Saturation

I worked to reach data saturation as it applies to my research study to validate my

findings. Reliability and validation are key components of qualitative research (Cypress, 2017). Validity in research is how a research study is constructed, if it can be replicated, and ensures multiple sources of supporting evidence have been introduced (Yin, 2017). One method to assist in assuring research validity is to reach data saturation. Data saturation is achieved by continuing the collection of data to the point where no new information can be garnered. Data saturation also occurs when further research is considered counterproductive because no new themes emerge (Saunders et al., 2018). Triangulation will help ensure data saturation is reached. Triangulation refers to drawing data or results from multiple different sources such as interviews and organizational documents for case study research until no more conclusions can be drawn (Von Borries, 2019). My research involved semistructured interviews as part of a case study approach where I looked at emerging patterns among the answers provided by my case study participants to reach data saturation.

Transition and Summary

Section 2 of my study outlined how my multiple-case research study was conducted. I discussed the role of the researcher, specifically my role in conducting my research, as well as the participants for my multiple case studies. I provided an overview of research methods and designs and what method and design my research study consisted of. I described population and sampling as well as how and why my case study participants were chosen. Ethical research is paramount to quality research, and I outlined how my research study followed ethical research guidelines. I have outlined data collection techniques and instruments as they applied to my research study, as well as how that data will be organized and analyzed. Section 2 finished with a description of reliability and validity and how both apply to my research study. In Section 3 I will conduct interviews with case study participants to explore successful strategies they have used in

combating firefighter injuries. Based on my findings from interviewing case study participants I looked for common themes among participants to make recommendations other fire service leaders can use to reduce firefighter injuries in their organizations.

Section 3: Application to Professional Practice and Implications for Change

The purpose of this qualitative, multiple case study was to explore strategies that fire service leaders use to minimize firefighter injuries. I interviewed seven fire chiefs from Massachusetts and New Hampshire. After analyzing the data, it became clear that not all of them were able to support their claims of implementing a successful injury reduction strategy. I removed two fire chiefs with no supporting data for a total of five case study participants who had implemented successful strategies to reduce firefighter injuries. All five case study participants had successfully implemented some injury minimizing strategies, although all of them acknowledged more needs to be done to reduce firefighter injuries. After analyzing the data collected, I was able to identify multiple themes: administrative policies or guidelines, PPE and PPE program, apparatus and equipment design changes, annual physicals, physical and mental health assessments, and education and training.

Presentation of the Findings

The overarching research question for this study was: What strategies have some fire service leaders implemented to minimize firefighter injuries? My research involved interviewing seven fire chiefs from fire departments in New Hampshire and Massachusetts. Each fire chief was asked seven interview questions and allowed to add any other information they deemed relevant. Depending on the participants' answers to the interview questions, a follow-up question may have been asked. Each interview was digitally recorded and transcribed. All seven fire chiefs I interviewed identified a successful strategy they had implemented, but in some cases, they lacked data to support that premise. Two fire chiefs lacking supporting data were removed from the study because they could not adequately support their belief that the impact of injuries in their organization was being minimized. The two chiefs removed were Participants 3 and 7. I defined a

successful strategy as one seen as being impactful at minimizing firefighter injuries based on data provided by the case study participant. An example of minimizing injuries would be a reduction in lost days of work due to injury. All considered a day to be 24 hours because firefighters work 24-hour shifts. All participants need to cover some or all lost days with off-duty firefighters who are paid time and a half to work. Each department has different pay scales, but the general range of overtime costs would range from $40 to $65 per hour, depending on pay scale and rank. The five fire chiefs remaining in the study each implemented multiple strategies and were able to demonstrate a positive impact on minimizing firefighter injuries in some areas. All have yet to yield data to support the reduction of injuries in all areas they have tried to address, and those areas were not included in the results.

Despite obstacles some fire chiefs faced, themes began to emerge as I analyzed participant responses after transcription. I considered three or more identical or close answers as a theme among case studies and recorded these in an Excel spreadsheet. I identified multiple themes among the five participants, many of which were identical answers for all five (see Appendix C). The themes I identified were related to injury minimizing strategies these fire service leaders have implemented. Injury minimization strategy themes consisted of administrative standard operating guidelines, apparatus design changes or equipment modification, PPE, education and training, and providing gear extractors for all fire stations. I also found one participant implemented a mandatory physical fitness program. This is significant because I found extensive data in the literature review demonstrating the importance and effectiveness of physical fitness programs.

Administrative Standard Operating Guidelines

All participants cited changes or implementation of injury reduction policies. If a program was implemented or modified to minimize injuries, I considered it a policy change because it did involve a procedure of some type. All participants implemented some type of administrative policy or policy change with the type of strategy they introduced.

Participant 1 implemented a comprehensive vehicle backing policy to help minimize injuries and equipment damage. This policy was developed in response to multiple accidents involving the backing up of fire apparatus. The backing policy involves proper PPE, such as high visibility vests, radio equipment for constant communication, hand signals, warning lights, and seatbelt use. Backing events were tracked in 5-year increments before and after the backing policy was implemented. Participant 1 demonstrated a 12.5% decrease in backing incidents after the policy was implemented based on data from his municipality's loss control specialist.

Participant 2 identified exposures at emergency medical responses as his Number 1 injury problem. After implementing administrative guidelines, offering training, and purchasing more user-friendly PPE, he saw his lost time injuries go from 5 days in 2019, to 1 lost day in both 2020 and 2021 to date. This is significant in that both 2020 and 2021 firefighters were operating during the COVID-19 pandemic. To see a reduction in lost time injuries because of exposures to communicable diseases during a pandemic indicates a successful approach.

Participant 4 purchased and adopted a complete set of standard operating guidelines written and developed for fire departments by a consulting firm called Lexipol. The policies developed by Lexipol can be modified to meet the needs of individual fire departments and are centered on reducing risk. The policies implemented by Participant 4's organization were based on personnel understanding processes and procedures and being accountable for their own actions

as they pertain to reducing risk. Implementing a complete set of policies developed by Lexipol was a multipart process for Participant 4. In addition to policy implementation, personnel were provided training and continue to be provided training annually. Training on policies implemented involves the proper use of equipment; proper lifting techniques for emergency medical response patients and equipment, including equipment on fire apparatus; and other specific areas. Participant 4's organization has not seen a drastic reduction in injury rates but has seen a 33% reduction in the financial impact injuries have had. This indicates the impact injuries are having is reduced compared to years past. Participant 4 cites the training associated with policy implementation as the driver for cost reduction and proper lifting techniques. Participant 4 covers every opening for his department. In other words, any time a firefighter is out there a cost to backfill that firefighter. A 33% reduction in backfill costs represents a significant reduction of about 37–40 days based on overtime rates in lost duty time due to injury.

Participant 5 has implemented a program of training and policy adoption in conjunction with the purchasing of new lifting equipment for his organization's ambulances. The equipment is designed to reduce the lifting of patients into ambulances by firefighters. Participant 5 recognized back injuries directly associated with lifting patients as his largest single cause of lost days due to injury.

Participant 6 implemented a comprehensive wellness program, and the written policy outlines the need of the program, the requirements of the program, and the process if a firefighter is deemed unfit for duty. All case study participants have introduced cancer prevention measures in their respective organizations, but Participant 6 has seen an impact. Participant 6 lost two firefighters to occupational cancer: One female firefighter who was 40 years old at the time of her death, and one male firefighter who was 39 years old at the time of his death. Participant 6

incorporated a mandatory cancer awareness program based on recommendations from the cancer support network. The cancer awareness program is part of the mandatory wellness program he has incorporated in his organization. The firefighters who were diagnosed and ultimately passed away from cancer in Participant 6's organization received their diagnoses too late. The female firefighter found out she had cancer the day she delivered her twins, and the male firefighter found out only after complaining to his coworkers about a metallic taste in his mouth for months.

All participants implemented policies directly related to the COVID-19 pandemic that began in 2020. Each strategy implemented by a fire service leader involves the adoption of or modification of a policy or guideline to ensure firefighters understand the program and are aware of the consequences of not following the program.

Apparatus and Equipment Design

All participants addressed either apparatus or equipment design focused on reducing firefighter injuries. Fire apparatuses can be very large to meet their mission of bringing personnel and equipment necessary to mitigate a variety of emergencies. All participants discussed some level of employee engagement in apparatus or equipment design to reduce firefighter injuries, such as a safety, apparatus, or equipment committee. Some participants provided data that modifications or equipment changes may have been part of injury reductions. Participant 5 added a new stretcher lifting system to the ambulances his fire department responds with to reduce back injuries. This lifting system takes the task of lifting patients into the ambulance from the firefighter to reduce the incidence of back injuries. Back injuries related directly to lifting ambulance patients were identified as a major injury in his fire department. Firefighter injuries related to lifting patients are more prevalent today because of the nation's increasing obesity problem (Lavender et al., 2020). In addition to adding a new stretcher lifting system, Participant 5

initiated specialized training for firefighters on proper lifting techniques. The addition of a patient lifting system by Participant 5 decreases the exposure firefighters have while lifting patients into ambulances and his injury statistics bear this out. Participant 5 demonstrated a drop in back injuries related directly to lifting patients over a 3-year period from 2018 to 2020. Participant 5 documented four back injuries directly related to lifting patients in 2017 resulting in 34 days of lost time. In 2018, Participant 5 demonstrated a drop in patient lifting-related back injuries to one injury, resulting in 16 days of lost time and an increase to two injuries but with 0 days of lost time in 2020. Overall, back injuries for Participant 5's organization dropped from 10 with 88 lost days in 2018, to 12 total back injuries with 73 lost days in 2019, to seven back injuries with 26 lost days in 2020. A lost day for Participant 5 is equal to 24 hours per day. Some of this injury reduction can be attributed to the equipment modification made to ambulances, and some can be attributed to education and training about lifting techniques.

Participant 4 made modifications to their fire apparatuses by lowering the hose beds and rearranging equipment compartments to remove equipment to make it less likely to cause injuries. Participant 4 has realized a significant cost savings related to injuries, estimated to be between 37 and 40 days of lost duty time. Some of this may be attributed to the apparatus design changes among other initiatives.

Other participants made different changes to their organizations' apparatuses and equipment. Participant 2 changed the brand of self-contained breathing apparatuses to provide a more ergonomically designed brand. Participant 6 purchased ground ladders that were significantly lighter in weight than what had previously been used. Participants 2 and 6 have yet to realize injury reductions related to lifting or equipment yet but do expect to see their numbers decrease in coming years. All participants cited specific types of injuries, such as sprains and

strains, consistent with the findings of Haynes and Molis (2016) showing as reasons for the strategies they implemented.

PPE

Multiple participants addressed issuing proper PPE to their firefighters. The one area where all five participants were consistent was issuing two sets of turnout gear to each firefighter and implementing a gear decontamination program. Each participant issues two sets of turnout gear to their firefighters so that when the primary set of gear is contaminated the second set can be put into use. Anderson et al. (2017) discovered firefighter attitudes about cancer were that it was inevitable. The danger of this is complacency when it comes to keeping their gear clean. By implementing a decontamination policy backed up by two sets of turnout gear, the decision to remove potentially deadly carcinogens from turnout gear has been removed at the subordinate level making the theory put forth by Anderson non relevant. The leader making this an organizational priority modifies the firefighters' behavior and, ultimately, could save firefighters from cancer-related illness or even death. With cancer rates believed to be as much as 14% higher in firefighters in their lifetime than the general population, this is a significant strategy, particularly when exposure to cancer-causing substances is from turnout gear (Harrison et al., 2018).

Participant 6 lost two firefighters to occupational cancer in 2011 and 2012, respectively, one male and one female. The male firefighter was diagnosed with a pancreatic tumor, and the female firefighter with breast cancer. In both cases, the deaths were ruled job related. Participant 6 has implemented multiple strategies aimed at reducing cancer, such as the gear decontamination policy, issuing two sets of gear, providing mandatory cancer awareness training, requiring annual physicals, implementing a mandatory physical fitness program, and providing training from a

CrossFit instructor. Participant 6 has not had a cancer diagnosis in his organization since the deaths of his two firefighters, the last of which occurred in 2012. All the strategies Participant 6 has implemented may have contributed to cancer prevention.

Each participant has ensured that a turnout gear extractor is available in each fire station to decontaminate and remove carcinogens from soiled, turnout gear. Harrison, Muhamed, et al. (2017) demonstrated that firefighters do not always properly decontaminate their turnout gear despite knowledge that gear can be contaminated with carcinogens. This finding reinforces the theory of firefighters believing cancer is inevitable that was put forth by Anderson (2017). With the implementation of a turnout gear decontamination program, all 5 participants have taken the decision to decontaminate gear away from firefighters and, in doing so, addressed behavioral issues associated with firefighter injuries.

Participant 2 addressed PPE for emergency medical responses. His organization had been realizing a high number of exposures to communicable diseases resulting in testing costs and overtime costs for lost time. His firefighters gave excuses for not wearing PPE when appropriate due to the fit and it is hampering their ability for timely patient care. His firefighters also had a lack of accountability for not wearing it. Not wearing PPE because it hampered a firefighter's ability to perform patient care is consistent with research conducted by Maglio et al. (2016) where goal fixation was found to be a cause of firefighters not wearing PPE. In the case of participant 2's people, the goal fixation was patient care, and while admirable, it had a cascading effect on the organization because of the unintended consequences of exposure. Participant 2 engaged the help of his firefighters in choosing PPE that was more comfortable, and in drafting policies aimed at when and how to wear PPE related to emergency medical responses. In addition, Participant 2 created the non compensated position of senior firefighter. The senior firefighter is meant to act

as a mentor to newer and younger firefighters adding a level of accountability not seen previously, particularly when it came to PPE. Participant 2 realized a reduction of 5 full days of lost time due to exposure to communicable disease to 1 day. When looking at the reduction from 5 full days to 1, it may not seem significant, but what is demonstrated in my research is the size of the organization. Participant 5 has a small organization, particularly when compared to other case study participants, in fact his organization is about 1/10 the size of Participant 1, and 1/8 that of Participant 4. The importance of this is that a reduction of 4 days for Participant 2 is considerable.

Fitness Programs and Annual Physicals or Physical or Mental Assessment

Multiple case study participants have addressed physical fitness to varying degrees. Participant 6 was the only participant who has implemented a mandatory physical fitness program, although all participants recognized the need. Participant 1 is providing annual physicals meeting the NFPA 1582 standard to their most at risk firefighters. That group of firefighters are those serving on specialty teams such as hazardous materials response and dive rescue, as well as those firefighters over the age of 40. NFPA 1582 is a consensus standard that outlines guidelines for physicians when conducting firefighter physicals with an emphasis on body systems most affected by firefighting duties (Bhojani et al., 2018). Participant 2 tried to implement annual physicals that meet the NFPA 1582 standard but was prevented from doing so by his town administrator. This is noteworthy because the labor group for Participant 2 was willing to participate. Participant 6 requires their firefighters to obtain and provide results of an annual physical from their primary care physician as part of the mandatory fitness program he has implemented. This is also part of the reduction in cancer cases in his organization. Participant 6 also requires his firefighters to participate in a mandatory mental health session or evaluation to help prevent post incident, or post traumatic stress. Post incident stress, and post traumatic stress

are known contributors to poor mental health and can lead to PTSD (Jones, 2017). PTSD can lead to increased alcohol use (Martin et al., 2017), and may lead to burnout, which in turn can contribute to the incidence of accidents (Katsavouni et al., 2016). The strategies implemented by Participant 6 are also recommend by Tobia et al. (2020) who recommend firefighter receive an NFPA 1582 compliant medical evaluation annually. All case study participants did talk about mental health and the importance of supporting their firefighters on an ongoing basis to help prevent mental health disorders from developing. Preventing mental health issues is crucial, and unfortunately, hard to quantify but the research suggests it is necessary in addressing injuries Smith, Mullins-Jaime et al. (2020) posited that the stresses of firefighting can lead to job burnout which puts firefighters at risk for injury, and other behavioral issues. This means an approach to total firefighter health, including mental health should be incorporated as part of a total worker health initiative. Preventing mental health issues is crucial, and unfortunately, hard to quantify but the research suggests it is necessary in addressing injuries.

Education and Training

Multiple case study participants provided specific training and education to their firefighters on specific area related to firefighter injuries. Participant 5 identified back injuries caused by lifting patients as an issue in his organization. He provided training on proper lifting techniques to help reduce that risk. Training and education in conjunction with modified equipment has resulted in a 70% reduction in lost time form lifting related back injuries. Participant 4 explained that his training division now works to teach proper lifting techniques to firefighters when taking equipment off fire apparatus or returning to fire apparatus. This was implemented in response to multiple shoulder related injuries. This was done in conjunction with apparatus modifications and his organization has seen a reduction in injury related costs of 33%

and some of this may be attributed to the training his firefighters receive in addition to policy and apparatus modifications. Participant 6 has implemented a mandatory cancer awareness program that includes information for and questions to ask your doctor regarding cancer. Participant 6 has also worked with a CrossFit instructor to provide education to his firefighters on the best techniques to use in their mandatory physical fitness program. With the implementation of injuries minimizing strategies, all case study participants have introduced some level of training and education to ensure the program is being followed properly. As an example, all case study participants have implemented a turnout gear decontamination program that uses turnout gear extractors. Turnout gear extractors require training for proper use to ensure gear is being fully decontaminated. Proper use of a turnout gear extractor reduces the exposure of carcinogens to firefighters. Reducing exposure to firefighters through proper decontamination of turnout gear reduces the cancer risk they face (Harrison et al., 2018). Training on cancer awareness is also a key component to reducing the impact of cancer in the fire service (Casjens et al., 2020).

Applications to Professional Practice

There were multiple strategies implemented by all case study participants I interviewed during my research. Most of the strategies implemented are no-cost items that involve guidelines to promote proper safety behavior. The goal of any policy is to influence or change behavior. In the case of my research study participants, they are trying to modify firefighter behavior. Research conducted by Maglio et al. (2016) concluded that in some cases, firefighter behavior contributes to not wearing personal protective equipment as it was designed and that firefighters do not perform turnout gear decontamination as diligently as they should. Policies or guidelines addressing these issues take the decision making out of the firefighters' hands. Participant 4 stated "If people know what the expectations are, they know how to act and behave." Participant

4 has seen a dramatic drop in financial cost associated with injuries that supports his approach to setting expectations to define behavior. Some of the strategies involve a long-term approach such as fire apparatus design. A piece of fire apparatus can last between 10 and 25 years depending on the amount of use it gets during its in-service time. A decision to modify apparatus to reduce injuries can impact multiple generations of firefighters even though it may be hard to quantify the injury reduction over time. Participant 5 noted he has seen a 70% drop in injuries related to lifting on the ambulance due to the equipment modifications made and his injury reports bear that out. Policies related to safety such as the seatbelt policy implemented by Participant 1 takes the decision of whether to wear a seatbelt out of the hands of the individual firefighter. Haynes and Molis (2016) put the number of apparatus collisions at over 15,000 in 2016 alone resulting in over 700 firefighter injuries and 19 firefighter deaths. In 2015 the number of apparatus collisions, firefighter injuries and deaths were even higher (Haynes & Molis, 2016). Based on line of duty injuries and deaths directly related to apparatus collisions being the second leading cause of firefighter line of duty death in 2016 (USFA, 2017), implementing strategies such as mandatory seatbelt use can help minimize firefighter injuries and deaths.

Physical fitness was seen by all case study participants as a major driver of firefighter injuries. Unfortunately, most participants cited a lack of cooperation with their respective labor group as an obstacle to implement a program. Participant 6 was able to implement a mandatory physical fitness program, and Participant's 1 and 6 have implemented an annual physical or mental health assessment. A higher level of BMI fitness in firefighters contributes to cardiovascular disease among firefighters (Bode et al., 2021). With cardiac related events being the largest contributor to firefighter line of duty deaths, annual physicals and fitness programs can reduce the likelihood of a cardiac event in firefighters. Fitness programs should include an NFPA compliant 1582 medical assessment annually to help protect firefighters from becoming at higher

risk for cardiac and other health-related issues such as obesity. Participant 6 was able to work collaboratively with his labor group to institute the mandatory fitness program.

Research by Johnson et al. (2020) demonstrated the unique challenges faced by firefighters in relation to mental health because of repeated traumatic exposures. Implementing mental health programs is a crucial component to long-term physical and mental well-being of firefighters. Failing to address the mental health of firefighters can lead to job burnout which research has demonstrated can be a factor in increased injury risk to firefighters (Smith, Mullins-Jaime et al., 2020).

Cancer prevention was also a top priority of all case study participants, and this approach should become an industry standard. Research has demonstrated that specific types of cancer are significantly higher among firefighters than rates among the public (Laroche & L'Espérance, 2021). Programs such as two sets of runout gear and proper turnout gear contamination can reduce or prevent exposures to firefighters increasing the likelihood of a cancer-free career. Annual medical evaluations and cancer screenings can help find cancer, hopefully in the initial stages so the survivability rate is higher (Gallagher, 2021). Gallagher (2021) posited that firefighters today are exposed to carcinogens by either skin absorption or inhalation, and unlike firefighters in the past, today's firefighters do not smoke. This suggests inhalation exposure when firefighters are not wearing respiratory protection. Administrative guidelines are put in place to outline the proper way of operating, and to ensure accountability to reduce instances whereby inhalation occurs. The goal of injury minimizing programs is behavior modification. Research by Smith, DeJoy et al. (2020) suggests safety specific transformational leadership approaches can modify firefighter behavior, the goal when it comes to minimizing firefighter injuries.

Each firefighter injury has the potential to impact multiple stakeholders such as the individual injured and their family, the organization they work for, the community they serve and ultimately the taxpayers funding the fire department. The financial impact may be severe because of direct impacts such as medical bills and can have a ripple effect by impacting the efficiency of the fire department or forcing other employees to cover for extended periods of time (Butry et al., 2019). Implementing some of the strategies outlined by the fire service leaders I interviewed can result in minimizing certain firefighter injuries both immediately and in the long term. Fire service leaders will need to be leaders in the truest sense, and not just in title, to make inroads to minimizing firefighter injuries.

Implications for Social Change

Firefighter injuries can be what are considered cascading events. The event produces injury to the firefighter which causes human suffering. In addition to the obvious human suffering by the recipient, is the impact the injury has on their families, and the operational readiness of their organization. Some organizations may be fortunate enough to be in a financial situation where the injured firefighter can be backfilled to maintain staffing levels. In other cases, the municipality may be forced to run with fewer people while still performing the same operational tasks. This may lead to further compromising the safety of the remaining staff. Even in cases where an injured firefighter is backfilled, there is a tremendous financial impact that may negatively impact the organization or community down the road.

Participant 5 cited the cost of back injuries as one example. His department paid $80,000 in medical bills alone for one back injury. His organization saw 0 days lost in 2020 compared to 16 days lost in 2019. A day is considered 24 hours, and replacement coverage for all overtime shifts is paid out at time and a half. Overtime rates for firefighters in Participant 5's organization

are between $37.50 and $44 per hour putting the cost of a single day at between $900 and $1,056. Reducing days lost from 2019 to 2020 for back injuries caused by lifting patients created a savings of up to $16,896. Participant 4 has seen a considerable drop in the financial impact of injuries. His organization has consistently budget $150,000 annually for overtime caused by injuries. In a 5-year period, he has seen his organization spend all the money budgeted each year, and in a few years need to appropriate even more funds. Last year (2020) the fiscal injury impact to Participant 4's organization was less than $100,000. This drop in injury costs is a direct result of fewer lost days due to injuries. Participant 2 cited exposure at emergency medical responses as the number one cause of injuries in his organization. Because of policy implementation, and a cooperative effort with his labor group to choose more suitable PPE, his organization has seen lost days to exposure drop from 5 to less than 1. Participant 2 cited 5 lost days in 2019 that required full coverage. That works out to 124 hours of lost time due to injury that were covered at between $46.16 and $54.66 per hour. Comparatively he had on 24 hours of lost time in all of 2020 and through August of 2021 combined, averaging out to less than 1 per year. In addition to actual lost time days, Participant 2 cited the cost of sending firefighters for testing which also requires overtime coverage, and the costs of tests or medications if necessary. Considering the cost of overtime rises incrementally with each fiscal year, Participant's 2, 4, 5, and 6 have realized a significant reduction in the financial impact injuries have on their respective organizations. This direct savings for the organization creates a savings for each respective community, and ultimately the taxpayer, as well as eliminates the human suffering a potential inured firefighter would have experienced. It stands to reason that a reduction in firefighter injuries nationally can result in large economic savings for municipalities, and ultimately taxpayers.

Recommendations for Action

The first recommendation I will make is for fire service leaders to develop better strategies to track injuries in their respective organizations. Injuries can be documented in the NFIRS, but that does not track all injuries, nor does it track impact or outcomes. Fire chiefs I interviewed all felt they were seeing a decrease in firefighter injuries, but not all could not prove it. Solid documentation that can illustrate the impact of firefighter injuries can help a fire service leader obtain funding for reduction programs. Along with better documentation is the recommendation of building relationships with community departments who may be able to help study data. As an example, two fire chiefs reported they could not get proper information regarding the injury costs of their personnel from the community's human resources division. While both fire chiefs were removed from my study it does illustrate the need for better intermunicipal cooperation. It is difficult for a fire service leader to address the problem of firefighter injuries without first analyzing the scope, impact, and extent of injuries in their organization.

Based on the research I have performed, and the answers provided by my case study participants, it is obvious that fitness needs to be a higher priority. I recommend fire service leaders work toward implementing wellness programs in their respective organizations. A wellness program should include NFPA recommended guidelines for physical fitness and firefighter physicals that help create solid baselines that can be studied each year for anomalies. Cancer is more prevalent in the fire service today than ever. Some of the programs I have outlined seek to guide decontaminating people and personal protective equipment to reduce the potential for cancer. While that is certainly a significant start, without using a physical that helps screen for cancer it may be difficult to measure the impact of the program. The same can be said for

personal protective equipment that is designed to shield firefighters from carcinogens. Another crucial aspect of wellness is mental health. In recent years, the fire service has seen a dramatic rise in active-duty suicidal ideation (Boffa et al., 2017). A comprehensive wellness program should address mental health and post traumatic stress. Other areas a wellness program should incorporate that may help reduce injuries are programs that help reduce the sleep deprivation firefighters' face. Sleep deprivation leads to poor health, which in turn has been proven to increase the incidence of injury.

Certainly, the strategies outlined by my case study participants involving upgrades to PPE are recommendations I would make. These involve ensuring each firefighter has multiple sets of well-fitting and useful turnout gear to provide the maximum amount of protection. Additionally, a gear extractor should be available for all firefighters with strict firefighter turnout gear requirements in place to ensure gear is being thoroughly cleaned.

Another and possibly more impactful recommendation is for fire chiefs to build and nurture relationships with the labor group representing their employees. All the fire chiefs I interviewed cited the labor group as the obstacle to reducing firefighter injuries. Almost every case study participant had the idea of a department mandated wellness or fitness program rejected by their respective labor group. In one case it was the town administrator, and in a case like that educating that individual may sway them to being cooperative. A labor group is charged with looking out for the interests of their membership. If a fire chief can forge a solid relationship built on trust, they may be able to get the labor group to understand the goal is organizational and individual improvement not individual harm to employees. Creating a safety partnership with the labor group so accountability for firefighter safety is shared may help bring the support necessary for changes. The key element of transformational leadership is for the leader to create situations

that create a benefit for the organizational leader and the subordinate. Reducing firefighter injuries creates benefits for all but the leader needs to be able to demonstrate that to the labor group. A strong relationship built on mutual respect and trust will certainly make any initiative more palatable for the labor group and much easier on the organizational leaders. One of the goals I had when I began the doctoral program was to be in a position to impact the fire service once I retire from active duty. I plan to share the lessons I have learned at symposiums, conferences and professional development seminars geared toward fire service leaders. Each year the International Fire Chiefs Association holds an annual conference called Fire Rescue International. The National Fire Academy holds an annual symposium open to anyone but is geared toward graduates of the Executive Fire Officer Program. The Fire Chiefs Association of Massachusetts hold an annual professional development program over a 3-day period. I am an active participant in all three of these groups and will work to pass on the results of my research to other fire service leaders.

Recommendations for Further Research

Three areas evolved as major impacts to firefighter injuries as my study progressed. The first emerging issue is cancer among firefighters. There is no longer any doubt that cancer is impacting firefighters at a higher rate than the public (Harrison et al., 2018). While research has been done on cancer types and rates among firefighters, there is still more research needed. Cancer rates in the fire service continue to climb, and this industry wide problem is worthy of more research. Cancer research should include a focus on how firefighters are becoming exposed, and how to limit those exposures. If things can burn and leak, I believe there will be the potential for carcinogens being released. Creating a barrier between firefighters and carcinogens may help reduce the rate of incidence. Limiting exposure to carcinogens will involve researching methods

to shield firefighters through personal protective clothing, as well as administrative procedures aimed at behavior modification. Researching effective early detection methods may not prevent cancer in firefighters but it may increase cancer survival rates.

The second, and faster-emerging issue in the fire service today is mental health. The horrific sites firefighters are exposed to are leading to rising incidents of post traumatic stress among firefighters. Firefighters and emergency medical technicians are exposed to stressful situations and are known to have higher rates of suicidal ideation than the public (Martin et al., 2017). Repeated exposure to horrific events is related to their work as first responders. More research is needed to develop strategies for building emotional resilience. Research has been conducted on developing peer support in the fire and other emergency services, but it should be expanded and built upon. Mental health issues in the fire service are dynamic and research should reflect the constant changes surrounding firefighter mental health.

Firefighter fitness is certainly one aspect related to firefighter injuries that is worthy of further research beyond what I have discussed in my research. There is extensive research tying obesity and lack of fitness to both injuries and to cardiovascular disease in firefighters. Research needs to focus on why the fire service industry has failed to adequately adopt fitness policies. Firefighters are required to have high levels of aerobic capacity as well as muscle strength and endurance (Stanek et al., 2017). All of the case study participants I interviewed felt that a lack of firefighter fitness was a contributor to their respective injury problem, although none of them could offer up supporting evidence. Given that strains and sprains remain the highest cause of firefighter injuries (Haynes & Molis, 2016), and that obesity can increase the risk of firefighters making injury claims by as much as 300% (Jahnke et al., 2017), finding strategies to increase

firefighter fitness need to be studied more. Perhaps more important is researching how fire service leaders and their respective labor groups can agree that fitness needs to be a priority.

Firefighters are human beings and the injuries they sustain do cause human suffering among multiple stakeholders. Injuries to firefighters are caused by multiple factors. Research moving forward could be narrowly focused on a topic such as firefighter physical fitness but expanded to include case studies from different regions of the country. This may allow for a richer collection of data and an expanded list of potential improvement strategies.

Reflections

The research process for my doctoral study has provided some valuable lessons for me as a leader. First, and possibly most important, fire service leaders have a duty and an obligation to work as hard as possible to keep their firefighters safe. When I began the research process, I incorrectly assumed that all fire chiefs were being proactive in trying to keep their personnel safe by instituting injury reduction strategies. The literature review process revealed that is not the case, and that was confirmed when I began looking at potential case study participants. One potential participant told me, “Yah, we’ve done nothing here to reduce injuries.”

Another lesson I learned is that stronger leadership development is needed as firefighters move up the ranks, and certainly before attaining the rank of a chief fire officer. As I stated previously, the question of defining what leadership approaches were used in injury reduction strategies yielded little in specific responses from my case study participants. I do not know if the lack of responses was humility or lack of knowledge how leadership theories are applied. One participant did say authoritative but couched his comments by adding tongue in check. He did explain that in some cases the approach needs to be that this is serious and needs to be done and is not open to debate. Participant 2 that he was working to create wins for both the organization and

the firefighters. Participant 2 did state transformational leadership was the approach he was trying to implement meaningful change in his organization. Other approaches are what I would describe as transformational because they set out to create benefits for both the organization and the individual employees even if the leader was unfamiliar with what they were trying to accomplish. The best examples of transformational leadership were Participants 2 and 6 who have successfully implemented new policies related to PPE and a mandatory physical fitness program respectively. Participant 2 worked with his group of employees and brought them in on the process so they could see how changes benefited them both as individuals and collectively.

The labor union in Participant 6 wanted a change in the shift schedule which his city negotiator was against. This fire chief worked with both sides and created a situation where both sides benefited. The city benefits because they will ultimately have a healthier fire department, and ostensibly fewer injuries moving forward. The labor group makes out because they get the schedule they want, and no additional costs have been incurred by either party. Also, the employees themselves will realize a benefit because they will be healthier with a mandatory physical fitness program in place. To a lesser degree, all the participants who instituted injury reduction strategies have utilized transformational leadership to create a benefit for all sides, and most importantly the organization. Participant 5 saw a drastic reduction in back injuries related to lifting patients, but his approach was more authoritative than transformational, and it remains to be seen if his approach will yield long-term behavioral change.

All case study participants have implemented strategies to proactively minimize firefighter injuries by preventing them. As an example, a fire department may have implemented a seatbelt policy whereby it is mandatory to be seated and belted anytime a fire department vehicle is moving, or other risk management strategies. Injuries to firefighters involved in

apparatus collisions remain high and are caused for a variety of reasons including driving behaviors (Bui et al., 2018). Because of annual injuries, a policy mandating seatbelt use in a piece of fire apparatus is considered a standard of care, yet if nobody had previously been injured there is no way to prove that it is minimizing injuries. Research conducted by Bui et al. (2018) demonstrated a reduction in emergency fire apparatus collisions after implementing risk management programs. Another example might be a program aimed at proper decontamination of a firefighter's turnout gear to prevent cancer by removing carcinogens that may contact the skin. Harrison et al. (2018) argued that decontaminating firefighter protective clothing can reduce the exposure risk of firefighter exposure to carcinogens. If no previous incidents of cancer have been found there is no practical way to demonstrate a reduction of injuries. Being proactive in reducing injuries starts with implementing strategies before injuries occur. All case study participants demonstrated they are willing to implement injury reduction programs based on industry best practices. In the case of the United States fire service, best practices would be strategies put forth by industry experts as those that can prevent or reduce injuries. These are the researchers cited in the literature review that have demonstrated injury reductions or lessening the financial impact of injuries. Other fire service industry best practices are based on consensus standards developed by organizations such as the NFPA.

In most cases the fire chief cited organizational obstacles that prevented them from implementing more injury reduction strategies based on their assessments of injury causes. The ability to forge and nurture the relationships necessary to not only carry out the mission of a fire department but to keep firefighters as safe as possible is closely related to the leader's ability. Being a visionary who can build trust among subordinates is not easy, and quite frankly, not everyone is cut out to do it. While it is impractical to think firefighter injuries can be eliminated,

it is realistic to believe drastic reductions can be achieved with strong leadership and consensus building between fire service leaders and labor leaders.

Conclusion

Injuries to firefighters continue to occur at a high rate annually and the economic impact remains high to communities across the country. Firefighter injury rates remain high despite changes in building codes, advances in technology related to training, ergonomic changes to fire apparatus, and advances in personal protective equipment. Fire service leaders must work to build consensus with their labor groups and develop strategies to combat the problem of firefighter injuries. Developing fire service personnel to lead fire departments now and in the future is crucial to the health and safety of firefighters during, and after their careers have concluded. Communities and fire departments need to understand the importance of strong leadership and work to develop leaders or bring them in from other organizations. Fire service leaders must do whatever is in their power to protect firefighters, sometimes from themselves. This can only be achieved with strong leadership that must be developed and nurtured throughout the career of a firefighter.

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Appendix A: Interview Answer Template

1. What strategies has your organization implemented to minimize firefighter injuries?

   Answer:

2. What has been the single biggest contributor(s) to your firefighter injuries?

   Answer:

3. What areas (i.e., operational, administrative, safety, etc.) has your organization addressed to reduce firefighter injuries?

   Answer:

4. Have the strategies your organization implemented addressed personal protective equipment?

   Answer:

5. How much of a reduction in injuries has your organization realized through injury reduction strategies?

   Answer:

6. On a per annum basis, what type of a reduction in financial impact has your organization realized because of injury reduction strategies that have been implemented?

   Answer:

7. Could you define the leadership approach that was employed to implement your injury reduction strategies?

Answer:

8. Would you like to add anything else?

Answer:

Appendix B: Interview Protocol Form

Interview Protocol-Anthony Stowers, Walden University

During the interview I will:	Script: You are being asked to take part in a research study aimed at finding successful strategies fire service leaders have used to reduce firefighter injuries. I will ask a series of questions to determine your strategic approach to minimizing firefighter injuries. As a researcher and fire service professional, I understand the dangers inherent to our profession. I am in no way judging any participant's approach, strategy, or leadership ability. Your answers will be transcribed and used as part of an overall multiple-case study report. I would like to schedule a follow-up interview with you later to discuss your answers as transcribed for accuracy. This process is called member checking and is important to aid in the validity of my research.
1. Introduce myself, the purpose of the interview, and ask for permission to record the participant's answers (see script). 2. Watch for non-verbal cues, i.e. observe to see if the participant is hesitant in answering a question or appears to hold back answers. 3. Use active listening techniques to analyze participant responses 4. Ask follow-up questions based on the participant's original answer to my interview questions to gain more understanding or insight.	
After the interview I will:	Interview questions:
1. Thank the interviewee: 2. Schedule a follow-up interview as part of the member-checking process.	9. What strategies has your organization implemented to minimize firefighter injuries?

	10. What has been the single biggest contributor(s) to your firefighter injuries? 11. What areas (i.e., operational, administrative, safety, etc.) has your organization addressed to reduce firefighter injuries? 12. Have the strategies your organization implemented addressed personal protective equipment? 13. How much of a reduction in injuries has your organization realized through injury reduction strategies? 14. On a per annum basis, what type of a reduction in financial impact has your organization realized because of injury reduction strategies that have been implemented? 15. Could you define the leadership approach that was employed to

	implement your injury reduction strategies? 16. Would you like to add anything else?
	Answers will be digitally recorded. All information collected during the interview will be transcribed for analysis and to conduct a second interview to perform transcript review, and member checking.

Follow-up Interview Protocol-Anthony Stowers, Walden University

During the follow-up interview I will: 1. Introduce myself, the purpose of the follow-up interview (see script), which should take no longer than 30 minutes. 2. Provide the participant with a two-page summary of their answers during the initial interview.	Script: This follow-up interview has been scheduled in hope that I have accurately recorded of the answers you provided during our initial interview. Ensuring my interpretation of your answers is critical in validating my research on what strategies some fire service leaders are using to minimize firefighter injuries. It is also an opportunity for you to add anything you may have missed during the initial interview. I may ask further questions because of your answers during our initial interview.
Conclusion: I will thank the participant for their assistance in my research project.	Follow-up Questions: 1. Follow-up 2. Follow-up 3. Follow-up 4. Follow-up

Appendix C: Data Collection Themes

Trend/Pattern	Case Study 1	Case Study 2	Case Study 4	Case Study 5	Case Study 6
Administrative Policies	X	X	X	X	X
Apparatus and Equipment Design	X	X	X	X	X
Personal Protective Equipment (PPE)	X	X	X	X	X
Education and Training		X	X	X	X
Turnout gear extractors for all stations	X	X	X	X	X