Outcome-based Community Risk Reduction Assessments

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CERTIFICATION STATEMENT

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

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Date: Feb 24, 2020

Abstract

The problem was that the Community Risk Reduction Bureau of the Indianapolis Fire Department has been unable to identify suitable outcome-based measures to accurately evaluate the effectiveness of their education and prevention programs. The purpose of this research was to determine suitable outcome-based measures for use by the Indianapolis Fire Department (IFD) to assess the efficacy of its community risk reduction programs. Descriptive research methods were utilized. The researcher sought to identify the data points the IFD's Community Risk Reduction Bureau (CRRB) was interested in analyzing. These data points were then studied to determine where the CRRB should focus its efforts. Once targets were identified, risk reduction programs and their desired goals were discussed. Output and outcome metrics were considered. The community risk and program assessment methods of similar departments were researched. Interviews were conducted in-person, on the phone, and through texts, direct messaging, and emails. Standards of covers and strategic plans from Indianapolis, Hartford, and Lincoln were examined.

The research produced a list of data points to be considered when assessing the community, service demand, and department performance. Studying the data revealed several issues and populations in need of attention from the CRRB; however, the current data lacked the necessary specificity to be truly impactful. IFD was already utilizing a handful of outcome-based measures. The sparse baseline data made it difficult to develop specific benchmarks for other programs. IFD is recommended to add census tract information to its incident reports, foster outside relationships with community partners, and develop outcome-based measures for all programs designed to measure how a program affects the risk levels of the community. Considerations for further research include how these approaches may vary in non-urban,

professional departments and how to more accurately assess outcomes beyond the initial incident.

Keywords: community risk assessment, outcome-based, assessments, risk reduction

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Outcomes-based Community Risk Reduction Assessments

The problem statement is the Community Risk Reduction Bureau (CRRB) of the Indianapolis Fire Department (IFD) has been unable to identify suitable outcomes-based measures to evaluate the effectiveness of their education and prevention programs accurately. Historically, IFD has maintained thorough records of its programs' outputs, such as programs offered, buildings inspected, and the number of its public contacts. In some cases, the department has wished to calculate the impact of its programs but has lacked the resources or abilities needed to do so. The purpose of this research is to determine suitable outcomes-based measures for use by IFD to assess the efficacy of its community risk reduction (CRR) efforts.

The author will utilize the descriptive research method. This research will be accomplished through face-to-face interviews with members of IFD's CRRB. Phone interviews will be conducted with members of various fire departments from around the country. Electronic communications will also be leveraged (e-mails, LinkedIn posts, and direct messages). Finally, the researcher will gather information from various fire departments' webpages regarding their CRR programs and assessment techniques.

The first research question is, "What are the key indicators used by the Community Risk Reduction Bureau to identify issues within the Indianapolis Fire Department service area?" The author will interview IFD's Planning Chief, Fire Marshal, Assistant Fire Marshal, and Captain of Public Education to learn their opinions. This will be supplemented with an examination of the department's 2019 Community Risk Assessment and Standards of Cover (CRA-SOC) (Indianapolis Fire Department, 2019b).

The second research question is, "Which needs does the current data suggest the bureau should concentrate on?" The author will research the data points selected through the previous

interviews. This research will be done using a combination of IFD's CRA-SOC (Indianapolis Fire Department, 2019b), supporting documentation (see Appendix A), and the U.S. Census Bureau's website.

The third research question is, "What are the desired outcomes of each implemented safety program?" The author will once again meet with the CRRB staff and discuss the goals of each program. These goals should involve a change in incidence occurrence, behavior, knowledge, or attitudes.

The fourth research question is, "For each implemented safety program, what are the trackable output metrics, how are they gathered, and what are the benchmarks?" This question will focus on the activities performed by the CRRB staff. Examples will likely include fire drills performed, violations corrected, and arson cases cleared.

The final research question is, "What metrics are other fire departments using to measure both the outputs and outcomes of their safety programs?" These answers will be gathered from interviews and electronic correspondence with leaders from other fire departments from around the country. The author will also leverage other department's websites to gain further examples.

Background and Significance

In 2019, IFD completed its first community risk assessment (CRA). This process highlighted several vulnerable populations and hazards within the department's service area. Many of these issues were already known, with prevention and education programs already in place to address their needs. Another finding was that the CRRB lacked efficient means to assess the outcomes of its current programs beyond merely measuring how many occupancies had been inspected or people contacted. The CRA study provided the department with an opportunity to reevaluate the entirety of its safety and prevention programs to ensure the most

pressing risks and hazards were being prioritized and that meaningful assessment measures were established and utilized.

Accurately measuring program impact is of high importance to the CRRB. The bureau is severely understaffed. Since 2007, IFD has undergone five mergers with local township fire departments, increasing the size of its response area by almost 500 percent (Courtney Gordon, personal communication, January 24, 2020). Despite this growth, the number of deputy fire marshals (primarily responsible for performing the department's inspections) has only risen from eight to ten (Courtney Gordon, personal communication, January 24, 2020). The number of dedicated public educators has gone from three to five (Courtney Gordon, personal communication, January 24, 2020). For perspective, a recent county-wide consolidation study suggested IFD should currently have 36 deputy fire marshals and 12 public educators (Ronald Marks, personal communication, January 25, 2020). With these limited resources, it is of the utmost importance that the community's highest risks are prioritized and addressed. It is even more essential to ensure that once a risk reduction strategy is put in place, it is successful in its aims. The number of times a curriculum has been delivered is meaningless if it is found to be ineffective. The CRRB must be mindful that its programs are well constructed, delivered effectively to their targeted audiences, and having their intended impacts. This thought process is congruent with the guidelines set forth by Vision 20/20 (Vision 20/20, 2018) and will help ensure the community gains the most utility from IFD's CRR efforts.

The Executive Analysis of Community Risk Reduction Student Manual (Federal Emergency Management Agency, 2018) lists four course goals, two of which are directly addressed by this research. This research seeks to enhance IFD's CRR efforts and focus on reducing risks in the local community. The research's first area of concern is identifying which

risks and hazards are in the most need of being addressed. The focus of the latter part of this research is on how to ensure that the department's efforts are effective at reducing risk.

This research is also aimed at meeting the United States Fire Administration's strategic goals. Primarily, it addresses "Goal 1: Build a culture of preparedness in the fire and emergency medical services (EMS)" (United States Fire Administration, 2019). Specifically, the research will satisfy strategic objective 1.1 "Enhance the fire and EMS' ability to identify, prevent, prepare for and mitigate community risks" (United States Fire Administration, 2019). The whole intent of this paper is to develop best practices for identifying the most significant risks facing the community and for the development of plans and measures to assure these risks are being addressed.

Literature Review

The author has broken down the literature review portion of this paper into four distinct areas. First, the history of CRR in the United States is examined. Second, best practices for conducting a CRA are discussed. The third focus describes how the CRA can be leveraged to identify and create CRR programs. Finally, the fourth section tackles different forms of program assessment.

History of Community Risk Reduction Efforts in the United States

Like most fire departments around the United States, IFD's mission statement speaks to protecting lives, property, and the environment. While many will instantly think of the acts of heroism performed on the fire ground or life-saving actions of those providing emergency medical services, this commitment to protecting and serving the community must involve both proactive and reactive measures. As Marchone (2016) alluded to, the fire service is charged with both prevention and mitigation responsibilities. When appropriately performed, CRR efforts

should have the net effect of protecting both the public and firefighters (Stoufer, 2016). It has been shown that well-designed measures and code enforcement have led to a direct reduction in line-of-duty-deaths (National Fallen Firefighters Foundation, 2014). Numerous other studies have also found that targeted education and safety efforts can have a significant positive impact on both the frequency of incident occurrence and incident outcomes (Cote & Bugbee, 1998) (Schaenman, Stambaugh, Rossomando, Jennings, & Perroni, 1990). The first step in designing winning CRR strategies is to identify the risks in the community (Vision 20/20, 2018).

The first recorded efforts at community risk reduction have been traced back to Portland, OR, in 1914 (Sawyer, Phillips, Catts, & Sawyer, 2016). This community boasts being the birthplace of home safety inspections (Sawyer et al., 2016). It was not until 1947 that CRR became a topic of national concern. At the request of President Harry Truman, the President's Conference on Fire Prevention was held (Sawyer et al., 2016). Eighteen states went on to hold conventions on the topic of fire prevention as a result, but little difference was made in the nation's growing fire problem (Sawyer et al., 2016).

In 1971, President Richard Nixon created the National Commission on Fire Prevention and Control (Sawyer et al., 2016). After a two-year study, the commission published a comprehensive report entitled "America Burning" (Sawyer et al., 2016). The report focused on the need for prevention and education measures to combat the ever-rising year-to-year fire loss totals (Sawyer et al., 2016). As a result, the Federal Fire and Control Act of 1974 was passed, establishing the National Fire Prevention and Control Administration (Sawyer et al., 2016). Four years later, the name was changed to the United States Fire Administration (USFA) (Sawyer et al., 2016).

One of the USFA's primary goals was to guide how departments around the country would address the problems and suggestions found in the report (Sawyer et al., 2016). This was especially true for providing leadership in the field of CRR (Sawyer et al., 2016). These efforts were supplemented in 1976 by the National Fire Protection Association's (NFPA) Learn Not to Burn program (Sawyer et al., 2016). The Learn Not to Burn program provided practical fire safety education for children between the ages of three and eight (Vision 20/20, 2020a). Safe Kids U.S.A. was created in 1988 to address preventable injuries (Sawyer et al., 2016). In 1998, NFPA began its Risk Watch program, a school-delivered curriculum covering all manner of injuries and situations, including fire and burn injuries, motor vehicle safety, and natural disasters (Vision 20/20, 2018).

Even after these efforts, America still had a fire problem. According to the Congressional Fire Service Institute (1999), the United States maintained the highest fire death rate of any country in the world (Medrano, 2013). Most of the literature on CRR efforts from this period focused on efforts to protect children, but many departments were also making efforts to address adult fire issues. The USFA produced training programs, pamphlets, and other prevention materials, which were free for departments to use during this time (National Fire Prevention Association, 2019a). Programs aimed at adults included lessons on cooking and cigarette safety, as well as the importance of having working smoke detectors in the home (National Center for Injury Prevention and Control, 1996). However, funding for the USFA remained sparse, making it difficult to spread its message and resources in a systematically effective manner (Webb, 2012).

Since the turn of the century, CRR efforts have gained momentum. Many other organizations have gotten involved to further the cause. The National Highway Traffic Safety

Administration and Center for Disease Control designed programs targeted at injury prevention that were embraced by the fire service (Moriguchi, 2015). The USFA and NFPA designed the Remembering When and A Fire Safety Campaign for People 50+ to target fire and fall-related issues in older Americans (Coatney, 2011). The Center for Public Safety Excellence (CPSE) and the Insurance Services Office (ISO) have both asked fire departments to examine their risk reduction efforts (Gilcrease, 2019).

The September 11, 2001, terrorist attacks on the World Trade Center shifted the focus towards a more global approach to risk reduction (Sawyer et al., 2016). Events such as Hurricanes Katrina and Wilma further highlighted the need for an all-hazards mindset (McDonald, 2015). The United Nations furthered this sentiment with the release of its Sendai Framework for Disaster Risk Reduction, a global approach to improving preparedness, mitigation, and recovery efforts in the face of catastrophic events (United Nations Office for Disaster Risk Reduction, 2020).

Arguably the most significant development in the advancement of CRR has been the advent of the Vision 20/20 program in 2008 (Vision 20/20, 2020b). While past programs had provided general recommendations to fire departments, Vision 20/20 was founded to create action (Vision 20/20, 2018). It provides a comprehensive risk reduction program, complete with specific actions to complete and benchmarks for which to aspire (Vision 20/20, 2018). Participating departments are expected to provide proof of their efforts and results (Vision 20/20, 2018). This shared data is then used to refine the program, further benefitting the fire service in the process (Vision 20/20, 2018).

The Vision 20/20 program is built around five strategies (Vision 20/20, 2018). The first strategy is advocacy (Vision 20/20, 2020c). Tools are provided to help fire chiefs advocate for

fire prevention both within their departments and in the greater community (Vision 20/20, 2020c). Outreach and education make up the second strategy (Vision 20/20, 2020c). The focus here is on identifying the most critical messages and ensuring successful delivery (Vision 20/20, 2020c). Strategy three considers the culture of the fire department (Vision 20/20, 2020c). The goal is to provide messaging and ideas for how to make CRR an accepted and vital part of the department (Vision 20/20, 2020c). The fourth strategy involves identifying and leveraging new technology (Vision 20/20, 2020c). Strategy five seeks to strengthen and enforce fire codes and standards (Vision 20/20, 2020c). These efforts protect both the public and the firefighters (Vision 20/20, 2018).

The Vision 20/20 project provides a plan for reducing risk in the community (Vision 20/20, 2018). The plan sets as its goal to "identify and prioritize local risks, followed by the integrated and strategic investment of resources (emergency response and prevention) to reduce their occurrence and impact" (Vision 20/20, 2018). This goal is accomplished by following a six-step process. The first step is to identify the risks in a department's service area (Vision 20/20, 2018). Next, the identified risks are prioritized based on their probability, consequence to the community, and impact on the department's ability to fully meet the community's other needs (Vision 20/20, 2018). Once priorities are established, it is time to develop strategies and tactics to mitigate the most critical risks (Vision 20/20, 2018). During this phase, it is vital to seek out external partners for collaboration and shared resources (Sawyer et al., 2016). Step four is to build a full community risk reduction plan using the strategies and tactics developed in step three (Vision 20/20, 2018). With the plan ready, the fifth step is implementation (Vision 20/20, 2018). Step six calls for monitoring, evaluating, and modifying the plan to ensure the desired

results are being achieved (Vision 20/20, 2018). While there are other community risk reduction models, the Vision 20/20 approach was the most comprehensive one the author came across.

The Vision 20/20 plan relies on the five "E's" when creating outcome measures. Education is used to heighten awareness and lead to more desirable behaviors (Vision 20/20, 2018). Enforcement pertains to both strengthening fire codes and standards and ensuring they are being followed (Vision 20/20, 2018). Engineering seeks to change a product or environment to lessen the risk level (Vision 20/20, 2018). Economic incentives use money or other tangible benefits to entice people to make safer choices (Vision 20/20, 2018). Emergency response is concerned with a department's response model and capabilities (Vision 20/20, 2018). No matter the risk in question, it can be addressed using one or a combination of these approaches. The combination of the six steps listed above and the five strategies shared here are state of the art for developing community risk reduction plans.

Performing Community Risk Assessments

There are many different angles to consider and explore when performing a community risk assessment. The student manual for the National Fire Academy's Executive Analysis of Community Risk Reduction course states that CRAs should be" proactive, strategic, and data-driven" (Federal Emergency Management Agency, 2018). To do so requires a department to have quality data with which to work (Sowers, 2019). Every effort should be made to ensure the foundation of the analysis (the data) is appropriate and accurate. From this data, the goal is first to identify and then prioritize the hazards found in the response area (Stoufer, 2016). These can be broken down into natural hazards, human-made hazards, and human-related hazards (Vision 20/20, 2018). As part of this analysis, the department should also consider any organizational vulnerabilities and their potential impact on the department's ability to provide services

(McGrady & Blanke, 2014). Input should be sought from external agencies and partners (Shearer, 2017) (Wodicka, 2013). The emergency management director should be contacted to assess the large-scale hazards facing the commnity, the secondary effects of significant events (Ludwig, 2016), and the department's role in their mitigation (Riley, 2011). As resources allow, this information is then presented in a visual format using geographic information systems (GIS) and visual aids (Crawford, 2005) (Riley, 2011). Once examined in its entirety, this information is then reconsidered by smaller planning zone areas (Gilcrease, 2019). This process should be performed once every five years (NFPA 1730, 2019).

Critical areas of focus include dentifying the vulnerable and at-risk populations and areas within the service area. FEMA (2017) describes vulnerable populations as those who "require functional services to maintain their independence, such as durable medical equipment, consumable medical supplies, and personal assistance services." Fernandez, Byard, Lin, Benson, and Barbera (2002) described the at-risk as those who possess "some combination of less access, more need, and little to no functional reserve to deal with change or stress without specialized support." As an example, the elderly are considered a vulnerable group. Within this group exists specific members who are at-risk. The at-risk members may perish unless there are plans made to ensure they receive their medicines and necessary health care during a catastrophic event. A failure to adequately prepare for such an event led to 61% of Hurricane Katrina's victims coming from those over 60 years in age (Al-rousan, Rubenstein, & Wallace, 2014).

Other lenses through which to view vulnerability include the risk for fire in a given area and economic concerns. The American Red Cross (2020) produces a Home Fire Risk Map that calculates the fire risk for each census tract. This map is created by considering home values, averqge age of home construction, building stock, and past incidents (American Red Cross,

2020). Key economic centers need to be identified, as well. These include both places of production and commerce. To this end, attention must be paid to the key activities, systems, and processes that drive a community (Johnson, 2019). The assets of historical and cultural importance should be identified, as well (Johnson, 2019).

The first step in performing a CRA is to identify the hazards in the community (Vision 20/20, 2018). This identification begins by thoroughly studying the characteristics of the service area. These are broken down into naturally occurring, human-made, and human-related (Stoufer, 2016). The naturally occurring characteristics refer to the geography, topography, geology, and physiography of a service area. (Center for Public Safety Excellence, 2016) The impacts and secondary impacts these can have on the occurrence and mitigation of emergency incidents must be considered (Center for Public Safety Excellence, 2016). Human-related characteristics refer to population, demographics, area economics, and socio-economics (Center for Public Safety Excellence, 2016). Human-made characteristics are concerned with areas of growth and development, the age and type of developments, service-type infrastructure, transportation routes, and human-made alterations such as canals, reservoirs, and storm relief systems (Center for Public Safety Excellence, 2016). Suggestions for data points and information to capture are contained in Table 1.

Table 1

Suggested Data Points to Capture in a Community Risk Assessment

Human-Related	Human-Made	Natural
Population	Critical facility types	Temperatures
Population density	Occupancies with suppression	Rainfall
Population by age group	Occupancies with alarms	Snowfall
Population growth rate	Building stock	Climate
Mortality rate	Structure age	Topography
Gender	Highways	Geology
Race	Waterways	Service boundaries
Ethnicity	Railways	Bodies of water
Median income	Utilities	High/low points
Education level	Property types	
English as second language	Occupancy loads	
Poverty rate	Water supply	
Home ownership	High rises	
Transients		
Average family size		
Unemployment rate		
Median age		

Note: (Center for Public Safety Excellence, 2016)

Another way in which hazards must be considered is in the form of historical incidence data. Departments should review three-to-five years worth of incident data (Vision 20/20, 2018). The types, number, and locations of incidents are to be gathered. Response times are calculated to the 90th percentile and broken down by call processing, turnout, travel time, and total response time for the first unit and effective response forces (Center for Public Safety Excellence, 2016). Other data stored in the computer-aided dispatch system (CAD), such as weather conditions, known hazards, or notes given by the caller, may also prove to be helpful (Werner, 2014). The records management system (RMS) can be used to find save and loss data, causes of fire, presence of working smoke detectors, sources of ignition, and causes of injury (Augustin, 2017). Other useful information sources would include police incident and hospital emergency room data (Biggerstaff, 2018). The combination of the community and incident response data should produce a reasonably accurate picture of risk in the community.

With the risks identified, the next step is to assess the threat they pose to the service area. The threat refers to the likelihood or probability an incident will occur (Vision 20/20, 2018). This assessment can be done based on historical data, subjective discussion, or a combination of the two (Vision 20/20, 2018). While historical data does not guarantee similar events will occur in the future, it is generally a useful guide from which to begin building a prediction (Center for Public Safety Excellence, 2016). Subjective discussion also has some merit, as it allows for anecdotal evidence to be considered (Center for Public Safety Excellence, 2016). Next, the consequence to the community of an event occurring is determined (Vision 20/20, 2018). Given the findings of the hazard review, consequences are rated based on a worst-case scenario (Center for Public Safety Excellence, 2016). This rating should also take into account the physical, economic, and psychological effects of the incident (Espinel, Shaw, & Shultz, 2012) (Hutchinson, 2015). The impact to the department of an incident occurring is rated. (Center for Public Safety Excellence, 2016) In order to determine this, the department creates a critical task analysis for each incident type (Center for Public Safety Excellence, 2016). From this analysis, effective response forces (ERF) are determined (Center for Public Safety Excellence, 2016). The ERF consists of the number of people and types of resources needed to cover all of the critical tasks for an incident type (Center for Public Safety Excellence, 2016). Knowing the ERF then allows the department to measure the impact any incident type would have on its ability to respond to other incidents (Vision 20/20, 2018).

An incident's threat (probability), consequence, and impact can then be used to determine the overall risk the incident represents to the service area. There are different methods for accomplishing this task, with the Heron model being CPSE's preferred means (Center for Public Safety Excellence, 2016). In the Heron formula, consequence and impact are scored on a scale

of two-to-ten (Center for Public Safety Excellence, 2016). Probability is based on the percent of a department's total run load an incident type represents (Center for Public Safety Excellence, 2016). These numbers are then used in the Heron formula to produce a risk score. Based on the appropriate class (fire, EMS, hazardous materials, or technical rescue), incident types are categorized into low-, moderate-, high-, or maximum-risk categories according to their risk score (Center for Public Safety Excellence, 2016).

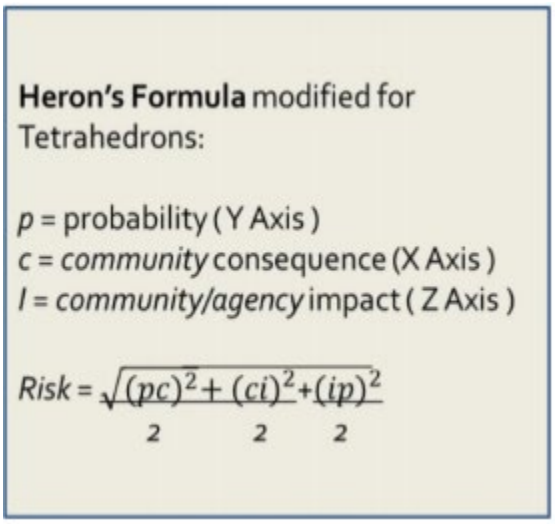

Figure 1 – *Heron Formula* (Hartford Fire Department, 2019)

When these processes are complete, a department will have most of what it needs to identify target hazards and populations. The next step is to identify other agencies and community partners that are also stakeholders (Biggerstaff, 2018) (Thomas, 2007). With partnerships formed, efforts should turn to developing and implementing risk reduction plans (Stoufer, 2016).

Identifying Target Hazards and Populations

Performing a community risk assessment provides essential insight into the needs of a department's population and helps identify high-risk and large-loss potential occupancies. Data gathered from the census bureau, partner organizations, and other open-sources regarding the

population can be used to identify vulnerable groups by being compared to current research and national trends (Kennedy, 2017). Layering this information on top of incident response data illuminates local trends and specific at-risk communities. Response data also provides an overview of the general types and number of incidents occurring in the service area. Information regarding occupancies and structures obtained through plan reviews, fire safety inspections, and external partner organizations is used to identify occupancy risk levels. These risk levels set the stage for inspection cycles, pre-incident planning priorities, and target safety education with high-risk, large-loss potential, and irreplaceable locations receiving the primary focus (Kennedy, 2017).

The results of pulling raw census data will immediately provide insight into vulnerable groups within the service area. Finding a high percentage of the population who use English as a second language would immediately inform a department that they need to consider how its safety and education information is being presented (Augustin, 2017). Studies have shown a strong indirect relationship between the percentage of owner-occupied housing and the number of fire incidents in an area (Huang, 2009). As such, one would expect to see a higher number of fires in areas with lower homeownership. Other studies have found the poverty rate to be of value when assessing risk (Istre, McCoy, Osborn, Barnard, & Bolton, 2001). As the poverty rate rises, typically, so do the number of fires, fire-related injuries, the average age of structures, and the use of alternative heat sources (Istre et al., 2001). Sadly, a high poverty rate is typically correlated with a low amount of safety education and training (Istre et al., 2001). National trends show that people in the 20-35 years old age group have the highest rate of fire-related injury but the lowest rate of fire-related death (Ahrens, 2013). Over 67 percent of fire fatalities in 2017 occurred in people over the age of 50 (Federal Emergency Management Agency, 2017b).

Combining an awareness of the current research and specific demographic and socio-economic information of a community provides a department with a rudimentary base from which to build its community risk reduction efforts.

Incident data can be used to gain a wealth of insight into issues and vulnerabilities within a service area. At its most basic level, incident data allows a department to discern the types, numbers, and locations of the incidents it is responding to (Stoufer, 2016). Departments should seek to know who is involved in these runs and when they are occurring (Martin, 2016). These numbers can be further supplemented by the addition of information from surrounding police, transporting, and hospital services (Biggerstaff, 2018). Basic performance can be assessed by measuring total response times (Stoufer, 2016) and save and loss data (Augustin, 2017). Save and loss data provided through the National Fire Incident Reporting System (NFIRS) should include information on contents and property, as well as injuries and deaths (Augustin, 2017). More granular information should also be available. NFIRS reports should include information on the race of victims in the civilian fire, EMS, and arson modules (Criddle, 2019). There are sections for information to be provided on the presence and activation of smoke detectors, alarm systems, and suppression systems (Dykes, 2011) (Martin, 2016). Ignition sources and the cause of ignition are also captured (Dykes, 2011). The annual incident data should be compared to previous years, national data, and data from similar-sized departments (Augustin, 2017).

At this point, it is worth adding a note of caution on data accuracy. The conclusions drawn from scouring an RMS are only as valuable as the accuracy of the information the system contains (Augustin, 2017). While incident data can be a powerful tool for addressing fire problems, improving resource allocations, and identifying training needs, this is only possible if the approach to gathering, entering, and analyzing data is structured and sound (Gilcrease, 2019).

Studies have shown that many officers are inadequately trained and undermotivated to accurately input all of the vital information the NFIRS report is capable of tracking (Gilcrease, 2019). Gilcrease (2019) found that less than 60 percent of departments offered formal NFIRS training. Perhaps, as a result, only 40 percent of departments were using NFIRS data to drive their CRR programs, and 36 percent reported never reviewing the data at all (Gilcrease, 2019). In order to address this problem, USFA provides free training modules and a comprehensive NFIRS reference guide on its website (United States Fire Administration, 2020).

The most beneficial insights are gained by overlapping information about the community with the incident response data (Sowers, 2019). This practice should be performed for incidents concerning each vulnerable group and the most significant incident types (Martin, 2016). For example, by examining the most common mechanisms of injury in automobile incidents by the victims' age groups, a department will be better informed as to the type of automobile-related safety programs it needs to produce. Taking this a step further, plotting the locations of these incidents would suggest where the programs should be targeted. A similar approach to analyzing all alcohol-related incidents has proven to be extremely beneficial, particularly to departments that serve a college community (Sowers, 2019). Another example is Denver Fire Department (DFD) using GIS technology to plot different EMS incident types and then cross-referencing this work with census data (Nassel, et al., 2014). This approach allowed the DFD to target the identified populations better and predict where similar issues may arise in the future based on demographic and socio-economic similarities (Nassel, et al., 2014).

Another key focus of a department's risk reduction efforts must be on the structures and occupancies found within its service area. This focus begins with the information gained from the initial building plan reviews. Details captured should include site access points, the strength

and location of the water supply, the presence of detection and suppression systems, and construction type, as well as any granted variances (Johnson, 2019). Files should continue to be updated through fire safety inspection reports, especially in terms of the processes occuring and products being housed at a location (Johnson, 2019). It is recommended for the department to have a system in place that weighs this information for each occupancy and produces a risk rating (National Fire Prevention Association, 2019b). The risk rating is then used to prioritize inspection cycles, with all high-risk occupancies receiving annual inspections at a minimum (National Fire Prevention Association, 2019b). These high-risk locations should also be targeted for pre-incident planning efforts and site-specific safety education (National Fire Prevention Association, 2019b). Studying the results of these risk assessments will suggest areas of the fire code that need to be strengthened and determine which variance types are the most common (Cherniske, 2015). Having this information then allows for adjusting the response model to specific addresses based on an occupancy's characteristics (increased risk factors result in a larger response, while suppression systems call for a reduction) (Hutchinson, 2015). There is also the possibility of providing this information to responding crews, as the Boston Fire Department does through an in-apparatus dashboard (Williams, 2019).

Once the vulnerable groups and locations have been identified, it is time to begin forming coalitions. Collaboration will be essential. It is desirable to ensure the department's administration and union play a role in creating CRR plans (Thomas, 2007). External partners, particularly those with similar missions and resources to invest, should be brought in (Schaenman et al., 1990). A place should also be saved for community groups and their advocates (Augustin, 2017). This is particularly true for the underserved (homeless and medically disadvantaged) and immigrant populations (White, 2016). Plans to ensure access to

essential resources for those most at-risk must be a priority (Hutchinson, 2015). Cultural issues need to be acknowledged and addressed, including providing education and safety messaging in multiple languages, as needed (Augustin, 2017) (Byrne, 2007).

With well-rounded coalitions in place, the work of developing community risk reduction programs can begin in earnest. The department should ensure that all programs meet both the discovered needs of the community, but also fall within the department's mission, vision, and values (McMullin, 2003). The health and wellness of the firefighters, in both emergent and non-emergent situations, should also be considered and addressed (Augustin, 2017) (Burgess, et al., 2019). As resource availability provides, additional program requests from the community should be honored (Medrano, 2013). Resources should also be dedicated to calculating and reporting on the cost of each program (Augustin, 2017) and building a data management system containing a target hazard database (Ludwig, 2016) and information on all CRR program efforts (Gudie, 2010).

Output and Outcome-based Assessments

Measuring program effectiveness is of the utmost importance. While a great deal of work is necessary to determine the needs of the community, a similar amount of care needs to be taken to ensure their programs are having their intended effects and are worth repeating (Byrnes, 2019). Assessment is especially valuable when it comes to justifying funding for these programs (Robertson, 2002). Departments should evaluate their programs early and often to identify areas in need of improvement and correct mistakes (Thompson & McClintock, 1998). If workable solutions cannot be developed, the programs need to be terminated so that their resources can be reassigned (Johnson, 2019). Unfortunately, building a high-quality assessment model can be complicated. For this reason, many departments are hesitant even to try. Recent studies have

found anywhere between zero and 75 percent of departments claiming to assess their CRR efforts, with the vast majority of the practitioners only tracking output statistics (Gerald, 2019) (Kieslow, 2004).

High-quality program assessment models include clear objectives, established baselines, and performance benchmarks (Thompson & McClintock, 1998). The specific data to be gathered and assessed is clearly defined and definitively linked to the objectives and benchmarks (Thompson & McClintock, 1998). The data collection instruments need to be designed and tested before being implemented (Thompson & McClintock, 1998). Once these instruments are validated, raw data can be collected (Thompson & McClintock, 1998). Whenever possible, data should be obtained from both target and control groups (Ta, Frattaroli, Bergen, & Gielen, 2006). Ideally, the raw data is scrubbed, processed, and analyzed by a data analyst. Finally, the results are evaluated, and decisions are made on the effectiveness of the program and any changes that need to occur (Thompson & McClintock, 1998).

USFA's Vision 20/20 (2018) project suggests utilizing four different types of evaluation. Formative assessments are concerned with the origination process of a program, its goals and objectives, and the development of its methods and materials (Vision 20/20, 2018). Process evaluations concentrate on outputs such as which programs are delivered, how many times, and to whom they were delivered (Byrnes, 2019). Impact evaluations examine the extent to which knowledge, attitudes, and beliefs are changed as a result of an intervention (Byrnes, 2019). Outcome measurements search for proof of changes in behaviors and incident results (Vision 20/20, 2018).

The formative evaluations are concerned with the origins of a program, the establishment of objectives and goals, and the development of the materials and methods to be used (Byrnes,

2019). A program's origin begins with the data suggesting there is a need not being met in the community. Goals and objectives should be created to be specific, measurable, achievable, relevant, and time-bound (SMART goals) (Vision 20/20, 2018). Using SMART goals provides guidance and a sense of urgency to ensure all efforts are moving the program towards its intended outcomes. Some departments incorporate the use of job performance requirements (JPR) for members of their CRR teams (Cass, 2017). JPRs for risk reduction may include demonstrating public speaking skills, curriculum delivery, and written communication abilities. Choosing the proper delivery methods is critical (Vision 20/20, 2018). Methods include utilizing classroom presentations, leveraging social media, and designing and moderating websites and online forums (Martin, 2016). They may also include media campaigns and external partnerships (Moriguchi, 2015). Finally, formative evaluations include designing and critiquing feedback mechanisms, such as feedback surveys for use with the public, students, and teachers (Cremeans, 2011) (Medrano, 2013).

Process evaluations monitor how the program is being implemented (Vision 20/20, 2018). While estimates can be made during formation, a department will want to know the cost and how many hours it takes to deliver a program (Augustin, 2017). This information is then used to establish workload measures and project the total resources needed to reach the target audience (Crawford, 2005). As process evaluations are concerned with the number of people reached, it is essential to remember that the focus needs to be on effectiveness over efficiency (Crawford, 2005). Merely touching a large number of people does not ensure a significant impact will be made (Robinson, 2016). That said, output metrics are an important part of understanding how changes in the impact and outcome metrics have occurred.

Impact evaluations seek to identify changes in the knowledge, skills, and abilities of those receiving the CRR programs (Vision 20/20, 2018). One standard method is to apply "before and after" tools (Gudie, 2010). Recipients are asked to fill out a pre-test (Gudie, 2010) or survey (Criddle, 2019) before receiving the program. This form is used to assess their baseline knowledge and attitudes. After the program has been completed, another survey or post-test is administered to determine any changes (Criddle, 2019) (Gudie, 2010). Occasionally, these are followed up with another round of assessments months afterward to see what changes have been retained (Criddle, 2019) (Gudie, 2010). Certain programs may conclude with practical testing, where the students demonstrate their newly learned skills and abilities (Vision 20/20, 2018). Some impact assessment tools are less formal. Instructors may ask the recipients to sum up the lesson in one sentence, provide a brief summary, or finish the instructor's sentence (Harrison, 2015). The instructor's impression of these subjective assessments should be recorded for later review (Harrison, 2015).

Perhaps the most important type of evaluation is outcome assessment. Outcomes assessments are designing to detect changes in behaviors and incident causatums, which is the purpose of any CRR program (Byrnes, 2019). These evaluations can be performed using both quantitative and qualitative measures (Vision 20/20, 2018). Vision 20/20 provides several examples of quality outcome measures for different types of programs. Plan review and inspection programs may be assessed by evaluating the change in the number of violations found during fire safety inspections after an awareness program has been executed (Vision 20/20, 2018). Changes in the number of working fires and the percent of fire damage per incident would also serve this purpose (Vision 20/20, 2018). Public education programs can be assessed by measuring the reduction of incidents involving a targeted call type (senior falls or child

vehicle accidents) (Vision 20/20, 2018). After performing a smoke detector blitz, departments may track the number of incidents where a working smoke detector was noted in the NFIRS report (Vision 20/20, 2018). These reports could be further explored to include data on the lives and property saved as a result (Vision 20/20, 2018). EMS programs may be assessed by weighing the changes in the department's return to spontaneous circulation (ROSC) rates and the percent of stroke cases in which the patient was delivered to the hospital within 30 minutes of the event (Vision 20/20, 2018). Finally, economic outcomes can also be examined. Economic impact topics include the length of occupant displacement, loss of sales and tax revenue, and the number of employee work hours lost (Vision 20/20, 2018).

There are several examples of these assessments being used around the country. The Memphis Housing Authority implemented a smoke detector enforcement policy that held its tenants responsible for ensuring they possessed a working alarm (Dykes, 2011). As a result, the average number of working fires per year dropped from between 70-80 to under four (Dykes, 2011). A smoke detector blitz in Oklahoma City cut the number of fire-related injuries per year by 74 percent (Mallonee, et al., 1996). A study in Morehead, KY, found that a community-paramedicine approach, in which hospital patients were regularly checked on in the weeks immediately following their discharge, cut their readmittance rate within the next 30 days by almost 50 percent (Cardarelli, et al., 2018). These measures are examples of how programs can be shown to be effective.

Summary of Findings

It is surprising to the author that community risk reduction did not receive more attention before the 1970s, although he recognizes that the budgeting and remit of the fire service fifty years ago may have been considerably different from today. While fifty years covers more than

two generations, it is still a relatively short period in the history of the fire service. Community risk reduction is just now emerging from its infancy state. In the time between the publishing of America Burning and Vision 20/20, models and best practices continuously evolved and improved. Today, industry leaders are focusing on how to assess and tweak their efforts to ensure the community is benefitting in the areas that matter most. The research contained in this paper looks to build off of the lessons learned in the recent past and move the Indianapolis Fire Department closer to performing actual outcome-based evaluations of its community risk reduction efforts.

One of the most significant takeaways from the literature review was the need for a wide-reaching approach for community risk reduction. While the majority of the focus will always be on identifying at-risk groups, vulnerable areas, and addressing the incident types posing the greatest threat to the community, attention must also be given to firefighter health and wellness. Disaster preparedness is another topic that should be explored. Once identified, IFD needs to seek out partners whom possess the desire and available resources to collaborate on solutions to these threats and risks. Code enforcement and fire safety inspection programs have a significant role to play, as well. It will be vital to successfully sell the significance of risk reduction efforts to the department's membership, as they will likely play a considerable role in program implementation.

Each program needs to have clearly defined objectives and benchmarks. While these are important for tracking success, they should also be written in a manner that lends itself to program advocacy. The department should be able to present a compelling case for why the program is needed, what it plans to do, and how the intended outcomes will benefit the

community and department. This message will help sell the program both internally and to external stakeholders, which is a key for securing partnerships and funding.

The people who will be administering the programs need to be empowered and prepared for success. This preparation begins with developing a solid knowledge base of the issues facing the community. Ideally, the presenters would play a significant role during a program's formation process. If an intervention's methods require classroom instruction, the staff needs to be trained in teaching techniques and learning styles. Inspectors and plan reviewers must be well-versed in the fire code and enforcement procedures (preferably gaining the proper certifications). The proper technology also needs to be provided so that the programs can both be executed appropriately and records can be maintained of both program delivery and outcomes.

IFD's approach to community risk reduction has mostly followed the plan set forth by Vision 20/20 (Vision 20/20, 2018). Risks have been identified and prioritized. The department's community risk assessment included almost all of the factors suggested in the various literature sources (Indianapolis Fire Department, 2019b). Many strategies and tactics have already been formulated and enacted through formal plans. The literature review suggests that the department should increase its efforts to collaborate with other agencies and external partners. Interventions should be designed to solve problems using the five "E's": education, engineering, enforcement, economic incentives, and emergency response. The department also needs to shift from mainly utilizing process and impact evaluation techniques to the inclusion of outcome-oriented assessments.

Regarding the performance of a community risk assessment, the literature suggested a few areas IFD would benefit from exploring. The most recent CRA did not include data from

the Indianapolis Metropolitan Police Department (Indianapolis Fire Department, 2019b). It also lacked hospital and emergency room data. These data sets may prove valuable in gaining a clearer understanding of the risks and threats present in the community. Quality assurance (QA) methods need to be in place to ensure the internal data being analyzed is accurate. QA is an area the department has struggled with in the past. IFD would also benefit from utilizing GIS tools to overlay different data sets on maps. These maps would provide helpful tools for quickly identifying areas of concern, patterns, and predictions for where future issues might arise.

The literature review provided many quality insights into how to identify at-risk and vulnerable populations. IFD already considers raw census and incident data when identifying its community focus areas but would benefit from taking a more layered approach. This type of approach would allow for risk reduction efforts to be more targeted by narrowing down the specific groups and locations experiencing a given incident type or hazard. The building of coalitions with minority and immigrant advocacy groups is another area IFD should further explore. Feedback and cooperation from these groups would be invaluable in ensuring the communities that they represent are reached and successfully impacted.

The most significant suggestions taken from the literature review regarding this research paper pertained to program evaluation. Different forms of evaluation are needed at different stages of an intervention's life cycle. Formative assessments are necessary both while initially constructing a program and also at regular intervals to ensure the issue still exists, the objectives are still pertinent, and the material is still relevant (Vision 20/20, 2018). While IFD has historically kept records of public contacts, it would benefit from performing process evaluations to uncover the total cost and resource commitment required for each of its programs. This information is necessary to gain a clear understanding of the return on investment for each

program. Regarding impact evaluations, IFD regularly incorporates pre- and post-tests into its curriculum; it lacks a means of recording and analyzing these results over time. The literature review suggested the creation of a database, as well as the development of surveys, practical skills tests, and subjective measures to assess changes in knowledge, skills, and opinions.

The primary focus of this research paper is creating outcome-based assessment measures. To this end, Vision 20/20 (2018) provided several direct examples, some of which the department is already utilizing. These examples included measuring the change in the annual number of fires occurring each year, trip and fall incidents within the elderly population, and juvenile firesetter cases reported each year. Each program (sometimes in concert with other interventions) should be designed to address a specific risk or issue in the community. The goal, in almost all cases, should be a reduction in incidence occurrence or improvement in outcomes. Program assessment measures should be created with this idea in mind. The real challenge will be to design outcomes-based measures that examine secondary effects and outcomes such as how long occupants who suffer a fire loss are displaced from their home, what was the outcome for the structure (replaced, remodeled, or demolished), and what were the financial impacts for the family (Vision 20/20, 2018).

Procedures

The first step performed by the researcher was to reference the 2019 IFD Community Risk Assessment-Standards of Cover (CRA-SOC) and its supporting documentation (Indianapolis Fire Department, 2019b). The CRA-SOC was available through the department's resource website. The supporting documentation was made available through the Planning Office (documentation was stored in a protected file on the department's shared hard-drive). These documents provided a base of 15 different census statistics pertaining to both the full

service area and individual station response areas (see Table 2). Incident data from 2016-18, as found in the CAD, was also included for the entire service area. 2019 CAD incident data was then combined with the 2016-18 data (see Table 3). A count for each incident type was produced, and the percentage of the overall incident load each incident type accounted for was calculated (see Appendix A). IFD's current strategic plan was also examined (Indianapolis Fire Department, 2019a). To further supplement this information, the Marion County Public Health Department's 2018 Health Equity report was downloaded and reviewed (Marion County Public Health and Hospital Department, 2018). The researcher realized late in the process that he had access to information from IFD's Health and Safety Division through the monthly executive staff meeting reports (see Appendix B). This information was reviewed.

The next step was a face-to-face interview with IFD's Fire Marshal (Chief Courtney Gordon), Assistant Fire Marshal (Captain Stephen Rowland), and the Captain of Public Education (Aleatha Henderson) (personal communication, February 11, 2020). Attendees were presented with the paper's five research questions ahead of the meeting. To start the interview, Henderson provided a detailed plan for how the public education program plans to identify needs in the community, construct interventions, and assess program performance (see Appendix C). Henderson also produced emergency room statistics she had recently received from Safe Kids Indianapolis (see Appendix D). The group was asked which data points they felt were the most informative regarding at-risk and vulnerable populations. Conversation then turned to what information would the CRRB like to see provided by the Planning Office. Henderson produced a list of CRRB's current programs (see Appendix E). Intended outcomes were discussed, as were the output metrics and benchmarks of the CRRBs current programs. Both Henderson and Rowland provided copies of their most current output assessments (see Appendices F and G).

The interview ended with a discussion of the CRRB's current plans and capabilities regarding the development of outcome-based assessments.

The final research question was, "What metrics are other fire departments using to measure both the outputs and outcomes of their safety programs?" The interviewer began his research by posting, "Does your department utilize outcome-based metrics to assess your community risk reduction efforts?" on LinkedIn (Wilson, 2020). This post generated responses from Dan Munsey of San Bernadino County Fire Department, Brent Faulkner of VirtualCRR.com, Bart van Leeuwen of Netage B.V., Travis Hollis of Cape Girardeau Fire Department, Reginald Freeman of Hartford Fire Department, Michael Despain formerly of Lincoln Fire and Rescue Department, Tom Fagan of Lawrence Fire Department, Joe Powers of Charlottesville Fire Department, and Zachary Wells of Kern County Fire Department (Wilson, 2020). As a result, direct messages were exchanged with van Leeuwen, Powers, Freeman, Fagan, Munsey, and Greg Rogers (Wilson, 2020). A similar post was made to groups of students from the researcher's previous Executive Fire Officer Program classes via the GroupMe mobile phone application (GroupMe Incorporated, 2020). The posts asked, "What do you deem to be the most important metrics to consider when choosing and developing community risk reduction programs, and how are you evaluating these programs after they have been performed – preferably in terms of outcome-based metrics?" (GroupMe Incorporated, 2020). Emails were then exchanged with Fagan, Rogers, Faulkner, and John Bennett of Telluride Fire Protection District. While researching van Leeuwen's Netage B.V. company, the researcher learned that Bloomington (IN) Fire Department was utilizing the service (Netage B. V., 2020). At the suggestion of Despain (Wilson, 2020), the researcher visited and researched the Lincoln (NE) Fire and Rescue Department website (City of Lincoln, Nebraska, 2020). The City of Hartford's

Standards of Cover was also examined (Hartford Fire Department, 2019). The researcher sent a direct message on Facebook to the Bloomington Fire Department page (City of Bloomington, IN - Fire Department, 2020). This initial interaction resulted in email and text exchanges with Jason Moore. Phone interviews were then conducted with Powers, Freeman, and Moore.

All of these interviews and exchanges, as well as the website research, were conducted by the researcher directly. The phone interviews lasted anywhere from ten to twenty minutes. The primary purpose of each was to learn how these departments were assessing their programs. Questions were asked regarding how departments determined where to focus their CRR efforts, which programs they are currently performing, and which performance metrics do they collect and analyze. In the cases where outcome-based metrics were being utilized, further information was sought. Program challenges and successes were also often shared..

Limitations

The analysis of the data pulled from the CAD was based on the initial incident type rather than the final incident types. While having final incident type would have been preferred, there were concerns about the accuracy of the data both stored in the CAD and the RMS. Although it is not perfect, studies of the initial incident type are reflective of service demands and the type of incidents the public and telecommunicators believe they are experiencing. Another small issue with using the CAD data was that the process involved melding data from two different CAD systems. Each CAD utilized different variables for denoting incident type. Only 11 incidents from the old CAD were unable to be paired with an incident type in the new CAD. Regarding census data, the census categories that had been researched during the CRA-SOC process were not a direct match with those requested by the CRRB. A substantial limitation was the inability

to layer census and historical incident data using GIS tools. Efforts are underway to remedy this situation, but they were not completed as of the time of this writing.

The interview with IFD's CRRB experienced a handful of limitations. All parties would have benefitted from the presence of the CRA-SOC (Indianapolis Fire Department, 2019a) in the meeting room. The same could be said for the presence of the census data the Planning Office had analyzed as part of the CRA-SOC formation process. As a result, the conversation regarding census data was more general than specific. The data Henderson provided from Safe Kids Indianapolis was also general in that the print out of the slide show was too small to see the hard numbers and categories easily (the slide show was later obtained via email) (see Appendix D). The interview was a bit more freeform than the researcher had intended. Participants were encouraged to explore different trains of thought as they arose. Considerably more time was given to the public safety and education programs than code enforcement. Except for the Fire Marshal, the fire investigations program was unrepresented. The Health and Safety Division was also unable to attend. Miscommunications and misunderstandings are possible during interviews; this was negated by a long history of communication betweent the researcher and the CRRB members.

Many of the researcher's external contacts resulted from a passive approach. The researcher posted a comment on LinkedIn and invited others to respond. While its number of views exceeded 1,600, the post only appeared in the news feeds of those who were either connected to the researcher or those who commented, shared, or liked the post. Luckily, most of the people who did reply were highly reputable sources and very experienced with the subject matter. A more proactive approach may have resulted in increased participation. The proactive approach was utilized with Rogers and Moore, who were contacted unsolicited by the researcher.

Utilizing direct messaging, as opposed to posting on the original comment thread, meant that the conversations were private. While this allowed for more honesty, it eliminated the opportunity for respondents to feed off of each other and occasionally resulted in redundant conversations.

Many of the previously mentioned limitations applied to the email and phone interviews, as well. While most of the conversations began with a similar set of questions, the researcher let the conversation go where the respondent wanted to take it. While this resulted in a rich variety of topics and ideas being discussed, the approach made it difficult to compare one interview to another. This process may have benefitted from these conversations happening in an open forum setting where people could react to extrapolate on each other's ideas. An open forum would have also lent itself towards ensuring each interviewee had a chance to address each new topic that developed over the course of the research. Finally, the researcher took extensive notes on each interview but was not able to capture each conversation verbatim.

Results

The CRA-SOC (Indianapolis Fire Department, 2019b) contained information on 15 different data points pulled from the 2018 American Community Survey (United States Census Bureau, 2020). This data displayed some interesting trends. The percentage of the county's population that was under the age of 18 years old was higher than the national average (25:22.6), while the percentage of the population that was over 65 years of age was lower (11:14.9). The median household income was substantially lower in Marion County than the national average ($43,369:$56,516). The unemployment and poverty rates were also almost twice the national average (9:4.9 and 21:12.3). While the percentage of the population identifying as a person of color was higher than the national average (43:38.7), the percentage of households with English as a second language was lower (7.3:9.6).

Table 2

2018 American Community Survey Statistics for Marion County, IN

Population <18	Population >65	Median Age	Persons of Color
25%	11%	34	43%
Median Household Income	Unemployment Rate	Poverty Rate	Families on Food Stamps
$43,369	9%	21%	17%
Homes Owned by Occupants	Homes Rented	Life Expectancy at Birth	English as a Second Language
54%	46%	76	7.30%
Property Crimes per 1,000 Citizens	Violent Crimes per 1,000 Citizens	Opiod Overdoses per 1,000 Citizens	
122.6	29.9	2.13	

Note: (Indianapolis Fire Department, 2019)

Each of the 15 data sets was also broken down by IFD station response area (Indianapolis Fire Department, 2019b). A few new data sets were added. It was found that Stations 18 (39 percent) and 33 (31 percent) had large Spanish-speaking communities (no other station areas were above 15 percent). Five stations were identified as having a poverty rate of over 40 percent, with 11 more stations exceeding 30 percent. Only 12 of the department's 43 stations exceeded the national median household income. Unemployment is rampant in the core of the service area, but it is less of an issue as one gets closer to the county lines. Property crimes well exceed national averages throughout the service area, while violent crimes are more centered in the middle of the county. Comparing vacant structures from IFD's service area to the county as a whole, each of the stations in Battalion 5 exceeds the county average. Nine station areas were found to have median home values under $50,000. There were high numbers of residential construction permits in Stations 3, 22, and 31 areas, suggesting these older neighborhoods were

undergoing renovations. The full data sets can be found in the CRA-SOC (Indianapolis Fire Department, 2019b).

The 2016-19 incident data was examined by count and percentage of total incident load per incident type (see Appendix A). The most prevalent EMS runs included a-codes for chest pain, difficulty breathing, injured person, accident with personal injury, seizure, sick person, and unconscious person. The most prevalent fire incidents included building alarms, residence alarms, investigations, residence fires, and trash fires.

Table 3

2016-19 Initial Incident Types by Incident Code

Incident Type	Occurences	Percentage of Overall Incidents
Sick person a-codes	42,581	9.73%
Difficulty breathing a-codes	41,276	9.43%
Unconscious person a-codes	36,139	8.26%
Chest pain a-codes	35,155	8.03%
Accident with personal injury a-codes	23,260	5.32%
Injured person a-codes	22,780	5.21%
Seizure a-codes	17,884	4.09%
Building alarms	12,340	2.82%
Residence alarms	10,313	2.36%
Residence fires	5,385	1.23%
Investigations	4,832	1.10%
Trash fires	4,832	1.10%

Note: Only EMS incidents types eclipsing 4% and fire incidents eclipsing 1% were included

The incident data from each station response area had only been broken down by class and category (Indianapolis Fire Department, 2019b). The station areas with the most fire incidents included Stations 7, 13, 14, 20, and 29. The stations areas with the most EMS incidents included Stations 7, 10, 20, 27, and 29. The most technical rescue incidents occurred within the response areas of Stations 5, 7, 13, 23, and 29. The most hazardous material incidents occurred within the response areas of Stations 7, 10, 20, 27, and 44.

The Health and Safety report (see Appendix B) showed the department had 874 injuries as of December 1, 2019, 279 of which were compensable. 92 injuries occurred on the fire ground, while 79 happened during EMS incidents. There were 23 reports of and 21 confirmed exposures. Work performance evaluations had been performed by 1,056 department members. After receiving their physical fitness evaluations, 78 members were required to take exercise perscriptions, and 207 were recommended to receive one. The firefighter wellness and safety program had received 1,214 contacts. Of these contacts, 151 had centered on substance abuse, 115 on family or social issues, 67 on post-traumatic stress disorder or acute trauma, and 2 were due to suicidal ideation. There had been 115 department vehicle accidents, 85 of which were deemed preventable. Of these accidents, the majority involved striking an object. There were 11 backing accidents and 6 accidents involving bay doors.

What are the key indicators used by the Community Risk Reduction Bureau to identify issues within the Indianapolis Fire Department service area?

Henderson (personal communication, February 11, 2020) was very interested in incident data. She started the interview by sharing information she had recently received from Safe Kids Indianapolis pertaining to emergency room visits by people between the ages of 0 and 17 years old (see Appendix D). This information was aggregated from each of the hospitals within Marion County. She stated that she would like to get similar information, particularly hospitalizations by injury type for each age group, from the hospitals regarding all age groups. There were questions as to whether the data represented in the Safe Kids report included incidents that had occurred in Marion County, involved Marion County residents, or were treated at Marion County hospitals. Henderson was going to follow-up on that question. Concerning

those under 17 years of age, she stated her concerns were with injuries due to falls, burns, and children being improperly restrained in vehicle.

Henderson then inquired about the possibility of gaining both fire and EMS data from the department's RMS. From this data, she was curious about the ability to discern the mechanism of injury or injury type for each call. She wanted information on the presence of smoke alarm, whether they had correctly functioned, the cause of ignition, and the ignition materials for working fires. From the community risk assessment, she wanted to know the top 10 injuries from the service district. Ideally, this would be presented at the service area level, as well as by station or neighborhood. She wanted to see census data regarding low-income families, minority populations, and populations by age group. The end goal would be to create heat maps of the city with incident data placed over census data.

Rowland (personal communication, February 11, 2020) also shared the data points he was most interested in examining. He wanted to use the RMS to track how many fires were being reported as occurring in vacant structures. He stated a desire to have counts and causes for fire injuries to both firefighters and civilians. For buildings with suppression systems, he was interested in learning if the system performed as expected and if it successfully contained the fire to the room of origin. Other data points Rowland requested were alarm and false alarm runs. Finally, he would like to see reports on the types of occupancies that are experiencing fires. For all of these requests, he would ideally like to break them down between residential and all other structures.

Which needs does the current data suggest the bureau should concentrate on?

In the interview (personal communication, February 11, 2020), Henderson stated that she had received little incident data from the operations bureau in the past. As such, she had been

using national data to determine which programs to pursue. She stated this data suggested a need to focus on child vehicle safety, trips and falls in the elderly population, and providing working smoke alarms for at-risk neighborhoods. Target areas were identified in conjunction with the mayor's list of blighted neighborhoods. Having only recently received the child injury data from Safe Kids Indianapolis, she noted that she would be focusing on falls, burns, and child passenger safety moving forward. She hopes to receive similar data in the future from the hospitals or Marion County Health and Hospitals.

Rowland (personal communication, February 11, 2020) stated that the Mobile Eyes inspection software allows him to keep track of issues with detection and suppression systems, but it does not provide information on working incidents. He has never made a formal request for the data points he alluded to while answering the first research question. There was some concern that even if the RMS was capable of producing reports with those data points, the information may not be completely accurate.

The raw data from the CRA-SOC points to a couple of areas of concern (Indianapolis Fire Department, 2019b). First, there are pockets of deep poverty within the service area. There is a direct correlation between service demand and the poverty rate in these areas. For example, the top ten station areas for incident occurrence all have poverty rates above 20 percent (five of the top incident areas have over 30 percent poverty rates). One-third of the households in Stations 18 and 33's response areas are speaking Spanish as the primary language. This data points to the need for providing education in Spanish and providing outreach efforts to learn how to serve these communities better. The large percentage of vacant houses in Battalion 5 represents a vulnerability.

The incident data shows that the primary EMS issues in the city include chest pains, difficulty breathing, injured people, accidents with personal injuries, seizures, sick people, and unconscious people (see Table 3). A study of fire incident data uncovers that building alarms, residence alarms, investigations, residence fires, and trash fires are the most common incident types (see Table 3). Unfortunately, this is based solely on CAD data. Data from the RMS may be able to shed light on the types of injuries that are occurring, more nuanced information regarding sick and unconscious patients, and details regarding the source of ignition and cause of fires.

The Marion County Public Health and Hospital's 2018 Health Equity Report (2018) suggested other areas where the department could focus its attention. Black, non-Hispanic residents displayed the highest levels of health inequity across multiple topic areas (Marion County Public Health and Hospital Department, 2018). White, non-Hispanic residents displayed more mental and substance abuse issues than other groups (Marion County Public Health and Hospital Department, 2018). Poverty was a direct indicator of health inequities and the presence of environmental hazards (Marion County Public Health and Hospital Department, 2018). Men were more likely to die by homicide than women, particularly as a result of gun violence (Marion County Public Health and Hospital Department, 2018). The difference in life expectancy varied by as much as 16 years from zip code to zip code within the county (Marion County Public Health and Hospital Department, 2018).

The data from Safe Kids Indianapolis (see Appendix D) illustrated that transportation injuries were far and away the most common cause of injury related emergency department visits. This was followed by falls and burns, with poisoning quickly approaching similar levels.

Of note, fall and burn injuries were much more prevalent in the 0-5 age group, but transportation and poisoning injuries saw significantly higher rates in the 12-18 age group.

What are the desired outcomes of each implemented safety program?

Henderson brought a document to the interview that listed each of the programs currently provided by the CRRB (Appendix E). While a brief description accompanied each program, none included specific desired outcomes. Henderson (personal communication, February 11, 2020) stated that the programs were not currently capable of creating SMART goals, as they lacked the necessary data to establish baselines. As most programs listed on the sheet were aimed at the youth, she stated that the overarching goal was to reduce youth fire-related injuries and fatalities. Exceptions to this norm were the FLAME program (targeted at seniors) and Fire WISE (targeted at local businesses). More granular data would be necessary to identify if the continuation of these programs was warranted and what the scope of the goals and benchmarks should be.

It is worth noting that the department's strategic plan (Indianapolis Fire Department, 2019a) outlines three overarching goals concerning its CRR efforts. By the end of 2024, IFD will reduce its fire loss total by 5 percent as compared to the 2016-18 baseline (Indianapolis Fire Department, 2019a). By the end of 2024, the department will reduce its number of working fires by 5 percent as compared to the 2016-18 baseline (Indianapolis Fire Department, 2019a). By mid-year 2022, the Community Risk Reduction Bureau will reach 100 percent of the community with safety education messaging (Indianapolis Fire Department, 2019a).

For each implemented safety program, what are the trackable output metrics, how are they gathered, and what are the benchmarks?

Henderson produced a detailed report of all trackable output metrics regarding the current CRRB safety programs (see Appendix F). This report primarily consisted of counts of the number of people contacted or who received the various safety programs. Numbers for Survive Alive were broken down into students in grades kindergarten through fifth, all other kids, and adults. Fire-related public education efforts were lumped mainly together. These output were broken down by kids in grades kindergarten through fifth grade, kids in pre-kindergarten, kids in junior and senior high schools, adults, and adults 65 years old and older. A count of those indirectly exposed to the programs' fire safety messaging was also recorded (booths at fairs and public events). The car seat program tracked the number of appointments made, seats given, and installations checked. The number of homes visited for home safety inspections and smoke alarms blitzes was tracked, as were the number of smoke alarms installed and the number of people served. Henderson tallied the number of Book Mobile events IFD attended and the number of kids and adults that were reached. The same was done for events utilizing the fire safety trailer. The Fire Stop program kept track of the number of referrals it received and interviews it performed. Finally, firefighter presentations and show-and-tells were also captured for both adults and children.

The above outputs are gathered by the staff who perform the training and outreach. Headcounts and contacts are written down and turned into Henderson after each event. These numbers are then entered into a spreadsheet. This spreadsheet is reviewed monthly within the CRRB and during the monthly executive staff meetings in the form of key performance indicators. Until 2020, the public safety and education program's lone benchmark was to reach 100 percent of the population each calendar year.

Rowland (personal communication, February 11, 2020) is currently tracking the number of inspections completed each month and year-to-date. The benchmark in 2020 is to inspect 33 percent of the inspectable occupancies in the service area. The numbers of violations found and corrected are both tracked every month. Inspections and violations are tracked through the Mobile Eyes inspection software by the parties responsible for completing the inspections. These reports are monitored by the Assistant Fire Marshal. There are currently no metrics or benchmarks on plan reviews.

What metrics are other fire departments using to measure both the outputs and outcomes of their safety programs?

The original post on LinkedIn resulted in 13 comments and was viewed over 1,616 times (Wilson, 2020). Dan Munsey commented that he was interested in the findings and suggested the researcher contact Brent Faulkner. Faulkner responded to the post by inviting further conversation and posting his email address. Travis Hollis tagged Bart van Leeuwen in reply to Dan Munsey. Bart van Leeuwen commented that measuring outcomes begin with recording the department's activities. He stated that his company, Netage B.V. helped the NFPA create a graph-based community risk reduction data model. He tagged Dr. Matt Hinds-Aldrich and offered to explain more. Reginald Freeman also replied to the original message with an invitation to speak more on the subject. Michael Despain suggested taking a look at Lincoln Fire and Rescue's most recent strategic plan. He stated it could be found on their website and that the last six-to-seven pages would provide some good ideas. Tom Fagan offered to share what the Lawrence Fire Department was doing and to meet up during the 2020 CPSE Excellence Conference. Joe Powers responded with an invitation to talk, as well. Zachery Wells also responded with a suggestion to read The Tyranny of Metrics by Jerry Z. Muller and The

PerformanceStat Potential by Robert D. Behn. From this point, individual communications began to take place via messenger applications, text messages, email, and phone calls.

Joe Powers is currently the Deputy Fire Chief of Community Risk Reduction at the City of Charlottesville Fire Department (Powers, 2020). He serves as a contract instructor, professional credentialing peer reviewer, and fire department accreditation peer assessor for the Center for Public Safety Excellence (Powers, 2020). For the past two years, he has also served as a technical advisor for Vision 20/20 (Powers, 2020).

On January 27, 2020, the researcher messaged Joe Powers, asking about which non-incident data points his department utilizes to both identify CRR program needs and to assess program efficacy (Wilson, 2020). A request to see any dashboards or program assessment tools his department was employing was also made. Powers responded that day with an invitation to call him directly. The phone conversation occurred on January 28, 2020 (Joe Powers, personal communication). Powers started the conversation by stating that it was hard to use output-based assessment strategies to drive service selection. He suggested starting by interviewing the fire company officers about the needs and hazards in their response areas. He said that he is finding it more valuable to study the service area in terms of its formal and informal communities rather than station response areas. This approach allows community risk reduction efforts to be genuinely community-specific. He acknowledged this approach presented difficulties with cleanly analyzing emergency response data, particularly for informal communities. Another suggestion was to utilize data from the real estate industry to gain a clearer understanding of the stock, age, and property use of occupancies in the service area. He specifically suggested matching the average last date of property sale to EMS data in order to forecast where certain incident types may be expected to increase in other areas of the city.

Speaking specifically to assessing outputs and outcomes, Powers said to look at it as a story. Find where the older populations are and target them with safety talks on trip and fall hazards, smoke detectors, and fire safety. Then match incident data in the coming months and years to where these lessons were presented. This data can be used to assess the quantitative benefits of the programs but can also be used to identify individual success stories. Department personnel can follow-up on specific incidents to learn the details of how the department's preventative measures helped residents experience improved outcomes. These stories can then be shared internally to boost morale and program support. They can also be reported on externally to sell the importance of continued funding. Powers stated that Henrico County Division of Fire had their data analyst pull every fire-related call where fire crews were on the scene for longer than 30 minutes and cross-reference those addresses with areas where fire safety programs had been conducted. When the outcomes were found to be positively affected, this information was sent out to the authority having jurisdiction, community partners, and the local media. He stated these efforts were crucial in securing the funding and tools needed to meet the CRR needs of the community.

Regarding fire, Powers said Henrico County recorded time-to-scene, water-on-fire, loss-stop, fire under control, and contained to the room of origin data. They also examined the time of day, neighborhood, and seasonal effects. If the fire spread beyond the room of origin, the reasons why were investigated.

All programs were processed quarterly. Information on how the strategic plan was progressing was collected before the quarterly meetings. All stakeholders were invited to attend these meetings, which generally lasted 90 minutes. The information shared in the meetings was also shared on a 3 foot-by-4 foot board at headquarters. This board included who was

responsible for each metric. Most of the information on the board was updated daily. Powers suggested to make the board big and to write directly on it.

Reginald Freeman is the Chief of Fire for the City of Hartford Fire Department (Freeman, 2020). He also serves as the CEO of the Freeman Group, LLC, director of training for the Caribbean Association of Fire Chiefs, an adjunct professor for the University of Florida, and a member of the board of directors for the NFPA (Freeman, 2020). After his reply to the initial LinkedIn post, contact was made through the application's messenger (LinkedIn, Incorporated, 2020).

On January 25, 2020, the researcher messaged Freeman and explained the scope of his research efforts (Reginald Freeman, personal communication) (LinkedIn, Incorporated, 2020). Several questions were then posed. First, which specific data points is Hartford using to determine where their community risk reduction efforts should be focused? Second, which program outputs are measured, how often, and are there benchmarks for each? Third, does Hartford utilize any outcome-based metrics? If so, how are the analyzed data collected and benchmarks created? Also, how often are these metrics reviewed and reported?

Freeman responded later that evening via messenger (Reginald Freeman, personal communication, January 25, 2020) (LinkedIn, Incorporated, 2020). To the first question, he stated that they look at response data for both fire and EMS by the city's 17 distinct neighborhoods. These neighborhoods were used to establish Hartford Fire's geographic planning zones. Freeman stated that this made tracking incidents and coming up with strategies very easy. Regarding outputs, Hartford monitors response times by shift and district on a monthly basis. The types of incidents occurring in each district are also captured. Public educations programs are also tracked monthly. These programs include presentations at all

schools in the city, community events, and neighborhood functions that are attended by educators and fire response apparatuses. Hartford's benchmarks include a reduction of fire incidents by 15 percent on an annual basis. Of outcome-based assessments, fire and EMS calls are tracked in real-time to produce up-to-date incident heat maps using mySidewalk (mySidewalk, Incorporated, 2019). This tool can predict which city blocks are the most susceptible to fire or EMS incidents by analyzing data from the CAD, RMS, fire marshal's office, city building officials, and the department's special services unit. After all fires, a "fire blitz" is performed in a two-block radius during which literature and public education regarding that specific type of fire are distributed. The message closed with an invitation to visit Hartford's website to see their FIRESTAT tool and standards of cover (Hartford Fire Department, 2019).

The researcher then visited the Hartford Fire Department website. The 2019 Annual Report (Hartford Fire Department, 2020) provided performance and benchmark data on response times to structure fires and EMS calls. This information was further supported in the standards of cover by the inclusion of baseline and benchmark performance statements for response times for all fire, EMS, technical rescue, and hazardous material incidents (Hartford Fire Department, 2019). The July 2018 FIRESTAT presentation was also found online (Hartford Fire Department, 2018b). This document included sections for subjective performance analysis and supplemental information like tracking the percentage of property saved and fire alarms as compared to actual fires. Fire and EMS scorecards were presented for each district and tour. CRR tracked activity hours, inspections performed, and training hours. The causes of fires were also traced. Special Services tracked hours spent on activities, emergency preparedness, public education, and special services. Finally, response data was displayed by incident type on a map.

After reviewing these documents, the researcher messaged Freeman on January 27, 2020 (personal communciation, January 27,2020) (LinkedIn, Incorporated, 2020). Freeman was asked how soon after a fire does a "fire blitz" occur and who is responsible for these duties. Other questions included asking which agencies his department partners with to gather the data mySidewalk uses to create their dashboard and how were those relationships formed. Freeman responded later that afternoon by asking for the researcher's phone number (personal communication, January 27, 2020).

On January 27, 2020, the researcher interviewed Freeman over the phone (Reginald Freeman, interpersonal communication). Freeman stated that the "fire blitzes" are performed by six cadets that work with the Special Services Unit. These events usually occur within 24 hours of a fire. This program was created in response to an abnormally high number of civilian fire deaths in the service area. These deaths were mainly attributed to unattended cooking fires, leaving doors open while sleeping, and electrical issues. The "fire blitz" program was created to spread safety education in the neighborhoods most often experiencing these issues. This program has had a significant positive effect.

Freeman said that FIRESTAT is powered by information directly from the department's RMS. The mySidewalk program utilizes incident data from the RMS, information from the CRA-SOC, and several other open data sources to give real-time feedback on incident risk. This information is available down to the census block level. Having the ability to easily keep the analysis current has been a significant benefit, as the city has seen massive changes in the last few years. Open data sources (local, state, federal, and non-profit) are updated monthly, while the RMS data can be updated at any time. The department is interested in tracking changes in population and population density, residents on assistance, and unemployment and poverty

levels. Analyzing the previous five years' data is the standard, but they can go back ten. Changes in the racial and ethnic profiles of the area are also analyzed. This level of specificity allows for the communities in the most need to receive highly specific messaging.

Tim Fagan serves as Fire Division Chief of Administration for the City of Lawrence, KS (Fagan, 2020). He also acts as a training coordinator and educator for the Center for Public Safety Excellence and is actively involved with the Heart of America Accreditation Consortium (Fagan, 2020). He holds a Chief Fire Officer credential, a Master of Science in Management, Strategy, and Leadership, and is a certified public manager (Fagan, 2020).

Fagan responded with a direct message on LinkedIn on January 25, 2020 (Tom Fagan, personal communication) (LinkedIn, Incorporated, 2020). He pointed out that response times and outputs do not tell the story of quality; but outcomes do. He provided the following examples: flame spread upon arrival versus extinguishment; fire loss in buildings with suppression systems versus those without; cardiac arrest save rates with bystander cardiopulmonary resuscitation (CPR) and without. Lawrence is building big data partnerships with the health department, public works, police, and anyone else who is interested in reducing risk through outcome-based findings and reduction initiatives.

On January 27, 2020, the researcher sent Fagan an email with two questions (Tom Fagan, personal communication). First, which data points does Lawrence use to determine where their CRR efforts should be focused and how often are these revisited? Second, which outputs and outcomes are tracked, how are benchmarks for each chosen, and how often are they reported and assessed? The researcher also asked about Lawrence's efforts to build big data sets. How did the process begin? What types of data sets are involved? What are the project's specific goals?

Fagan responded with an email on January 28, 2020 (Tom Fagan, personal communication). He stated that they track the causes of fires, the occupancy types where they occur, and any available data to associate with congruent factors for risk. For example, the department was able to identify that several fires were originating from medium-sized residential trash dumpsters, either next to the house or in the garage. This information was then cross-referenced with socio-economic factors. The result was a public information campaign to educate the community of the risks of flammables and these dumpsters. The public works department placed large warning labels on the dumpsters. The department also regularly produces information on social media regarding this issue. Fagan emphasized the importance of leveraging data from other agencies. He stated there might be value in comparing crime density, access to health care, socioeconomic factors, and other demographics to service demand. Fagan also stated that Lawrence reviews its emergency response data annually.

Fagan stated Lawrence tracks demand by call type and location. They also measure response time quality. He then discussed how measuring response times is the industry standard, but it is a drastically flawed metric for measuring actual performance. Lawrence's benchmarks for response quality are based on consensus standards. Benchmarks for outcomes are to improve on the baselines annually. Their goal for the forthcoming year is to incorporate outcomes into their benchmark performance objective statements. For example, on high-risk fires, not only do they want to have an effective response force arrive on scene capable of performing all of the identified critical tasks within their time benchmarks, but they also want to confine the fire to the floor of origin 95 percent of the time. A similar outcome-based assessment approach is being used for cardiac arrests. Time remains a crucial factor, but it is just one piece. He also shared a

flyer the fire department produced to encourage other agencies to share their data and collaborate on station placement.

Michael Despain is the former Fire Chief of Lincoln Fire and Rescue Department in Lincoln, NE (Despain, 2020). He has also served as an adjunct instructor for National University and Fresno City College (Despain, 2020). He was awarded the inaugural Randy R. Bruegman Agency Innovation Award from the CPSE in 2019 (Lincoln Journal Star, 2019). He has also served as an accreditation peer assessor for CPSE (Lincoln Journal Star, 2019).

Despain's response to the original LinkedIn post suggested that the researcher should view Lincoln's strategic plan (Wilson, 2020). He stated it could be found on the department's website (Wilson, 2020). Upon visiting the website, the researcher also found and studied the department's annual reports and standards of cover (City of Lincoln, Nebraska, 2020). The strategic plan included eleven initiatives, each with several goals. Initiative 1.1 was "to improve the survivability for victims of fire, hazardous material release, entrapment, or other crisis incidents" (City of Lincoln, Nebraska, 2020). This initiative included the goals of keeping the growth rate of structure fire incidents at or below the population growth rate, containing structure fires to the room of origin 80 percent of the time, meeting response time and effective response force benchmarks, having no civilian fire-related fatalities, and rescuing entrapment victims within 10 minutes of notification 90 percent of the time (City of Lincoln, Nebraska, 2020). The second initiative focused on EMS. Goals included meeting or exceeding the national average for cardiac survival rates, having an ambulance on-scene within eight minutes 90 percent of the time, and beginning basic life support (BLS) care within seven minutes of alarm receipt 90 percent of the time (City of Lincoln, Nebraska, 2020). Other safety-related goals included having zero firefighter line of duty deaths and maintaining an employee injury rate of below 20

percent of the total allocated staffing (City of Lincoln, Nebraska, 2020). Service-related goals covered maintaining a cost per capita below regional comparative averages and maintaining workers' compensation costs below 3.5 percent of the annual budget (City of Lincoln, Nebraska, 2020). Regarding value, goals of saving at least 95 percent of the value of property and contents threatened by fire, maintaining an ISO rating of Class 2 or better, and retaining CPSE accredited agency status were detailed (City of Lincoln, Nebraska, 2020). The results of the department's efforts towards reaching these benchmarks were then reported in the annual reports (City of Lincoln, Nebraska, 2020).

Three other conversations came out of the original LinkedIn post (Wilson, 2020), but none led to any pertinent developments. Brent Faulkner of VirtualCRR.com and the researcher exchanged a handful of direct messages and emails but were unable to find a time when both were available to have a phone conversation or product demonstration. The researcher was similarly unable to connect in a meaningful way with Bart van Leeuwen for similar reasons. The conversation with Zachary Wells ended up being of a more personal nature, with no further conversation about community risk reduction or assessment metrics.

One other conversation started as a result of interactions on LinkedIn (LinkedIn, Incorporated, 2020). The researcher read a post by Greg Rogers and reached out to him via direct message (personal communication, January 25, 2020) (LinkedIn, Incorporated, 2020), resulting in an exchange of emails. Rogers serves as a division chief for the Spokane Valley Fire Department (Rogers, 2020). He acts as a commissioner on CPSE's Commission on Professional Credentialing and holds a Master of Science in Management and Leadership (Rogers, 2020).

The first email (Greg Rogers, personal communication, January 27, 2020) contained a slide show presentation Rogers had recently delivered to his department's senior staff. This

information was presented by year from 2014-2018. The first five slides covered the number of inspection violations identified, satisfactory versus unsatisfactory inspections, violations by type, and violation data as reported through their third-party software. The next slides showed the number and percent of change from year to year for fire incidents and fire-related fatalities. The next three slides covered the number of investigations performed, investigations by case status, and investigations by ignition cause. These slides were followed by two with a focus on the building and contents value saved and lost by year from 2017-19. The next slide covered a particular incident. Illegal burn calls, the cost per student of school programs, and the results of the 2018-19 smoke alarm blitzes rounded out the presentation.

The researcher replied to this email with a handful of questions on January 27, 2020 (personal communication). First, there was a question about an abbreviation from the slide show. Second, how was the specific incident from the latter part of the presentation chosen for inclusion? Third, how willing are companies in the department's response area to release employment numbers and potential monetary save and loss data? Does the department typically collect this information for all commercial and industrial fires? Is there an available list of the department's community risk reduction programs? Finally, does the department look at anything aside from the three most prevalent incident types to determine which CRR programs to create or pursue?

Roger replied again on January 27, 2020 (Greg Rogers, personal communication). He answered the question regarding the abbreviation. Highlighted incidents are chosen at the recommendation of the fire investigators and through the analysis of fire incident save and loss totals. Companies have been open to sharing employment numbers and monetary loss information, but the department is sometimes required to perform some calculations to find the

totals. Property and content save and loss data are collected for every commercial and residential fire. The department focuses on the top three incident types for public education and flyers, but also has several other programs. These include programs for apartment managers and facility maintenance staff, elementary school students, middle school students, high school student CPR classes, Stop the Bleed, Spokane Valley Tech firefighter program, and fire extinguisher training. The email also contained a spreadsheet with monthly information on inspections, complaints, violations, and investigations.

In response to a message posted on the GroupMe mobile application (GroupMe Incorporated, 2020), John Bennett of the Telluride Fire Protection District (TFPD) sent the researcher an email (personal communication, January 30, 2020). Bennett is the district director for TFPD, where he was awarded the 2018 George Mazzotti Colorado Fire Chief of the Year (Criado, 2018). He is currently in the EFO program at the National Fire Academy.

The original post to which Bennett was responding asked what is considered the most important metrics to examined when choosing and developing community risk reduction programs, and how are these programs evaluated? Bennett replied with several examples for both questions (John Bennett, personal communication, January 30, 2020). Regarding the first, frequency of occurrence, the hours and workforce needed to solve the problem, and the extent of injuries and damage to the residents, firefighters, properties, and environment topped the list. He would ask if the problem is community risk reduction related. How long will the affected assets be out of service? What partnerships are available, and where will the funding to start and sustain the program be derived? For non-emergency related programs, what are the staffing requirements? What is the desired outcome, and which populations will be affected?

To the second original question, Bennett said he tracks the frequency of CRR events, the change in the cost to deploy, unit utilization metrics, buy-in and participation from developed partners, and if the project is staying within budget. He wants to know if the actual outcomes ended up matching the desired outcomes, what aspects of the program went according to plan, and how it can be improved moving forward. He summarized this by asking if the program was winning or losing, and why?

Jason Moore is the fire chief for the Bloomington (IN) Fire Department (Moore, 2020). He is the chief executive officer and founder of Infinite Consultation, LLC, and the chief operating officer of Jaxon Mattison Consulting, LLC (Moore, 2020). He also holds a Master of Business Administration in Management and Operations and a Master of Science in Project Management (Moore, 2020).

After sending a direct message to the Bloomington Fire Department Facebook page (City of Bloomington, IN - Fire Department, 2020), Moore replied with his phone number and a willingness to be interviewed (Jason Moore, personal communication, January 2020). The original Facebook message and reply occurred on January 28, 2020. Text messages were exchanged on January 29 and 30, 2020, with the phone interview occurring on January 30, 2020.

The interview began with a discussion on the Netage BV services Bloomington for which Bloomington had contracted (Jason Moore, personal communication, January 30, 2020). Moore said the program worked well with several other systems and open data sources. Before working with Netage, Moore had a desire to better leverage the community data that was available. He stated that Indiana University had a vast amount of data available. Initially, the goal was to improve pre-planning efforts beyond just examining census and building data. Moore then wanted to find a way to make this data available in a single-system interface to the firefighters.

He felt that Netage provided powerful query tools that included information on building specifics such as height, occupancy loads, occupancy types, and their age. Informatics specialists from the Luddy School of Informatics were used to build better visualization tools.

Changing the focus to community risk reduction, Moore stated his department's goal was to inspect every business, every year. Rather than worry about making contact with every person in the community, he focuses on making the most critical contacts effective. They have moved the focus away from pre-kindergarten through first grade presentations as they discovered through pre- and post-tests that second grade is where retention begins. Incident volumes and locations are monitored so that targeted messaging can be delivered. For instance, they noticed that a high number of fire alarm runs in the Indiana University dormitories were caused by burning popcorn and drying clothes in the dorm microwaves. The department was specifically then able to target these structures with messaging and safety information. Other trouble spots have been identified by creating sortable lists using 16 years' worth of data, with a focus on the previous two years. The top twenty incident types and locations were identified. These efforts recently identified three areas in need of social workers and two more in need of stricter code enforcement.

Discussion

The literature review suggested that the focus of community risk reduction efforts should be to create a positive impact on the frequency and outcomes of emergency incidents (Cote & Bugbee, 1998). The research found that each department had programs in place to meet these goals. Specific examples of these programs were Freeman's "Fire Blitz" program (R. Freeman, personal communciation, January 25, 2020), Fagan's dumpster fire initiatives (T. Fagan, personal communciation, January 28, 2020), and Moore's efforts in the college dorms (J. Moore,

personal communciation, January 30, 2020). Both Rogers (personal communication, Janaury 27, 2020) and Bennett (personal communication, January 30, 2020) spoke of studying incident data and building programs to address identified issues.

At IFD, Henderson and Rowland (personal communication, February 11, 2020) had a list of data points they wanted to use to identify the community's most significant risks and needs. The approach of identifying service area needs and designing programs in response to local data is new. Up to this point, programs were chosen in reaction to national data and trends. Occasionally, members of the community would ask for specific initiatives. The movement towards focusing on local data is a significant course change that will better align the department with the Vision 20/20 program (Vision 20/20, 2018). As will be discussed later, gaining the ability to strategically target the most vulnerable areas of a service area with precise messaging and tactics is invaluable.

At its best, CRR efforts should benefit both the public and firefighters (Stoufer, 2016), specifically, lowering the number of line of duty deaths (LODD) (National Fallen Firefighters Foundation, 2014). Only a few people explicitly mentioned focusing on outcomes for firefighters. Lincoln's strategic plan included goals of having no LODDs, maintaining an employee injury rate below 20% of the total allocated workforce, and maintaining workers' compensation costs below 3.5 percent of the total budget (City of Lincoln, Nebraska, 2020). Bennett (personal communication, January 30, 2020) spoke of monitoring both the number of injuries and the potential impact posed by hazards in the community to firefighters. At IFD, Rowland (personal communication, February 11, 2020) expressed an interest in tracking the counts and causes of firefighter injuries. The Health and Safety Division's monthly key

performance indicator reports are currently tracking several metrics regarding firefighter health and injuries (see Appendix B).

The research suggests that there is an awareness issue throughout the fire service regarding the inclusion of firefighter safety as part of risk reduction efforts. At IFD, firefighter health and safety garners a standalone division on the organizational chart. It is taken extremely seriously, with a staff of over 20 individuals and a sizable budget. Communication between the Health and Safety Division and the Operations Bureau is consistent, but there has been little to none with CRRB (A. Henderson and S. Rowland, personal communication, February 11, 2020). Risk reduction efforts have been primarily focused on public education and code enforcement. The good news is that the information being requested by CRRB is already being compiled, so this should be an easy problem to remedy. Like many departments, conversations need to be had to ensure risk reduction efforts take on a holistic approach. Several different models and approaches espoused the importance of doing so during the literature review.

For years, the primary focuses of CRR programs were children and the importance of smoke alarms. Programs such as Learn Not to Burn (Sawyer et al., 2016), Safe Kids (Sawyer et al., 2016), and Risk Watch (Vision 20/20, 2020b) all target injury prevention among the youth, particularly as related to fire . Departments were aggressive with messaging on the importance of having working smoke alarms in the home. A brief review of the interviews performed during this research will show that many of these programs are still not only prevalent but are the major focal points of several CRR programs. The vast majority of the programs Rogers (G. Rogers, personal communication, January 27, 2020) described were aimed at school-age children. The Hartford (Hartford Fire Department, 2019) and Lincoln (City of Lincoln, Nebraska, 2020) Standards of Covers also showed a focus on these same types of programs. A quick perusal of

IFD's CRR (see Appendix E) programs reveals that 12 of the 17 programs listed on the list provided by Henderson are geared primarily towards those under 18 years of age.

The youth will always be considered a vulnerable population per the definition provided by FEMA (2017). They are not yet fully physically or mentally developed and must rely on adults to provide for their basic needs. That said, a recent graphic presented by the NFPA displayed fire injuries by age group from 2013-2017 (Powers, 2020). The 0-15 age group had 26.5 percent fewer fire injuries than any other group (10-year intervals starting at 15 years of age) until the group age reached 65 years old and older. This difference would suggest that the youth programs were successful. It would also suggest that a greater need for education can be found in the 25-65-year-old groups where the number of injuries surged. This idea was a topic of discussion at the latest Vision 20/20 symposium (Powers, 2020). What this means for IFD is that it should begin program development with a clean slate, responding to the needs of its service area rather than taking the need for specific programs as a given.

The last topic of review on the history of CRR efforts found a push nationally towards all-hazards-related readiness and mitigation programs. The need for such programs was highlighted by terrorist events (Sawyer et al., 2016) and natural disasters (McDonald, 2015). Accounting for at-risk populations was found to be a significant concern, illustrated by the fact that 61 percent of the victims of Hurrican Katrina were over 60 years old (Al-rousan et al., 2014). For this reason, Ludwig (2016) suggested that departments should work with their local Emergency Management Director.

Freeman's (personal communication, January 27, 2020) was the only interview to speak of all-hazards education or planning. One of the metrics Hartford studies in its monthly FIRESTAT report is the number of hours dedicated to covering emergency preparedness

(Hartford Fire Department, 2018b). None of the other departments researched or people interviewed made mention of their departments' efforts in this regard. This research would suggest emergency preparedness is another topic (along with firefighter safety) that departments explicitly need to consider when creating community risk reduction plans.

Historically, emergency management has provided an opportunity for growth for IFD. The department is NIMS-compliant, with all sworn members having completed NIMS 100, 200, 700, and 800 and all officers having additionally completed 300 and 400 (Indianapolis Fire Department, 2019b). The issue has centered around IFD's lack of presence during the all-hazards collaborative process. In recent years, the police and homeland security departments have directly overseen the formation of the county's multi-hazard response plan. It is unclear to the researcher why the department has not been more actively involved in this process, but the fact that the department is only mentioned three times in the entirety of the Marion County Multihazard Plan speaks to how small of a role the department played in its formation (Arcadis, 2018). IFD's creation of a dedicated chief of emergency management position in 2019 was designed to increase the department's presence and involvement in these types of discussions. With this in mind, it is not surprising that the department has not focused on preparedness within its CRR plans. The community would be best served in the future by CRRB working with the chief of emergency management to ensure the populations that are most at-risk during disasters are appropriately addressed before, during, and after such incidents. This approach is advocated for by Vision 20/20 (2018).

Regarding the performance of community risk assessments, the literature review focused on identifying vulnerable (Federal Emergency Management Agency, 2017b) and at-risk (Fernandez et al., 2002) populations. It is important to note that there are at least two lenses

through which to view vulnerable and at-risk populations. First, these populations can be assessed by the likelihood of an incident occurring in their areas and the severity of the consequences of these events should they occur. The second lens covers disaster events. It is essential to develop plans and education components for both scenarios.

Powers (personal communication, January 28, 2020) spoke about identifying the older populations within the service area regarding specific incident types. Freeman (personal communication, January 25, 2020) discussed how Hartford utilizes the mySidewalk application to find the most susceptible neighborhoods for fire and EMS incidents. This use of big data to uncover at-risk populations is also mirrored in Lawrence (T. Fagan, personal communication, January 28, 2020) and Bloomington (J. Moore, personal communication, January 30, 2020). Of all the interviews and department research performed by the researcher, only Hartford's FIRESTAT report included information regarding disaster-related planning and education efforts (Hartford Fire Department, 2018b). This wide-spread exclusion of disaster-related planning and education once again highlights the need for its inclusion in future CRR planning and program development across the fire service.

IFD's primary means of identifying vulnerable and at-risk populations have relied on using anecdotal knowledge of the community and targeting the areas highlighted by the mayor as being blighted. Community groups and leadership would meet with the mayor and occasionally CRRB personnel to discuss their communities' needs. National programs were then applied or modified to meet the perceived issues within these areas (A. Henderson, personal communication, February 11, 2020).

In 2018, the department took a significant leap forward by producing its first formal community risk assessment (Indianapolis Fire Department, 2019b). For the first time, staffing

was dedicated to research and report on census and incident data within the service area. While these efforts were ultimately successful in identifying problem areas and at-risk populations, they were hampered by the initial inexperience of the data team and limitations of the CAD and RMS software. As positive strides have been made in both of these areas, the data team expects to develop a more granular breakdown of its data in the coming months. Broad issues have been identified regarding incident types and locations, as well as those related to demographics and socio-economics. The agency is poised to take the next step of further cross-analysis and a more granular approach. To that end, further conversations between the Planning Office and CRRB will be necessary to determine the specific data sets which will provide the most utility towards identifying specific vulnerable and at-risk populations and their locations.

The literature review found that it is also essential to identify where the highest fire risk resides. This assessment should be done in a few different ways. One method is based on identifying the community's key activities, systems, and processes (Johnson, 2019). Areas where these, and other vital assets, exist should warrant special consideration (Johnson, 2019). The loss of a mill or major factory may have economic repercussions from which a town cannot quickly recover. In cases like these, extra effort should be given to ensuring the fire code is enforced, pre-incident plans are created, and safety education is provided to the employees. The second method of assessing risk involves the use of objective data. Information on the specifics of an area's occupancies' is gathered and weighted. These data points should include facts such as the building's age, property use, construction type, and presence of detections and suppression systems (Center for Public Safety Excellence, 2016) (Cherniske, 2015) (Johnson, 2019).

The second approach was the most common. Powers (personal communication, January 28, 2020) spoke to his department's efforts to capture an occupancy's building stock, age, and

use. He suggested utilizing data from real estate sources, particularly the last date of sale. Areas with houses that have not been sold in many years may be housing an aging population. It may also point to deteriorating structures. Freeman (personal communication, January 25, 2020) pools information from his department's plan review and inspection efforts, city building officials, and other open data sources to identify high-risk structures. Fagan (personal communication, January 28, 2020) and Moore (personal communication, January 30, 2020) echoed the importance of utilizing data from as many sources as possible. None of the interviews mentioned specific concerns regarding the economic centers or areas of historical significance, but they were lightly covered in Lincoln (City of Lincoln, Nebraska, 2020) and Hartford's SOCs (Hartford Fire Department, 2019).

For years, IFD identified its high-risk occupancies based on the principals of people, products, and processes (S. Rowland, personal communication, February 11, 2020). The department's concerns regarding people centered on occupancy load and the types of individuals being housed, employed, or conducting commerce in an occupancy. Regarding products, the type and amount of products being stored at a location were a point of interest. The types of processes occurring in an occupancy were also of concern. High-risk occupancies were identified and inspected through the use of these measures. During the 2019 community risk assessment, these properties were mapped for each station response area (Indianapolis Fire Department, 2019b).

One by-product of IFD's accreditation journey was the creation of a new system for calculating occupancy risk (see Appendix H). This new system mandates plan review and inspection efforts are to capture twelve specific data points that are then used to calculate an overall risk score. Recording this data will allow occupancies to be ranked as high-, moderate-,

or low-risk (as opposed to the previous system of only having high-risk and non-high-risk occupancies). For each high-risk occupancy, the strategic plan calls for an annual inspection, the creation of pre-incident plans, and site-specific safety education (Indianapolis Fire Department, 2019a). In the beta-testing, a few new occupancies were identified as being high-risk, while a few others were demoted. These new findings need to be cross-referenced with a list of the most important economic and historical occupancies in the service area to ensure they are receiving the appropriate risk rating and proper risk reduction measures.

Both the CPSE (Center for Public Safety Excellence, 2016) and Vision 20/20 (Vision 20/20, 2018) approaches call for departments to breakdown the hazards in their communities into three groups: naturally occurring, human-made, and human-related. All three CRA-SOCs studied in this research provided a thorough review of the naturally occurring risks in their service areas (City of Lincoln, Nebraska, 2020) (Hartford Fire Department, 2019) (Indianapolis Fire Department, 2019b). Information on geography, climate, topography, temperatures, and precipitation was found in each. The most prevalent natural disasters were also covered. Powers (personal communication, January 28, 2020) was the only conversation that mentioned anything about studying the impacts of natural hazards when he discussed the value in capturing weather information via the CAD or RMS system for use when examining outlier response times.

IFD's CRA-SOC identifies and explains the natural characteristics of its service area that affect incidence occurrence and outcomes (Indianapolis Fire Department, 2019b). Protocols are in place regarding the dispatching and response models for significant events such as tornados, straight-line winds, and earthquakes (Indianapolis Fire Department, 2020). Standard operating procedures also exist for periods with extreme temperatures (Indianapolis Fire Department, 2020). As stated earlier, the department needs to incorporate disaster preparedness into its public

education programs and assure at-risk populations are being sufficiently served during such events.

Human-made risks include the buildings, infrastructure, and alterations made to the land, such as canals and reservoirs (Center for Public Safety Excellence, 2016). Each of these was thoroughly covered in the three SOCs reviewed (City of Lincoln, Nebraska, 2020) (Hartford Fire Department, 2019) (Indianapolis Fire Department, 2019b). That said, IFD's evaluation of its infrastructure was performed without much concern for serving specific at-risk populations in the event of a large-scale disaster. The department would benefit from revisiting this assessment after the at-risk populations and their needs have been more thoroughly identified.

The bulk of the conducted research focused on human-related risks. These risks primarily pertained to demographics, socio-economics, and incident response data (Center for Public Safety Excellence, 2016). There are multiple ways to examine incident response data. First, at least three years-worth (preferably five) needs to be reviewed (Vision 20/20, 2018). Incident counts, locations, and response times need to be assessed for both the entire service area and individual planning zones (Center for Public Safety Excellence, 2016). Secondary information to be considered includes when incidents are occurring (Martin, 2016), who is involved and affected (Martin, 2016), and outcomes such as injuries, fatalities, and save and loss data (Augustin, 2017). Departments would also benefit from tracking facts on ignition sources, causes of ignition, and information on smoke alarms and suppression systems from fire incident reports (Dykes, 2011). With EMS data, a department should be concerned with specific types of injuries, injury mechanisms, and time to care (Criddle, 2019). The summation of these efforts can then be used to help predict future service demands (Center for Public Safety Excellence, 2016).

Each person interviewed and department researched reported that they were reviewing their available incident data. Freeman (personal communication, January 25, 2020), Rogers (personal communication, January 27, 2020), and Moore (personal communication, January 30, 2020) all confirmed their departments were using at least three years' worth of data for risk and performance analysis. The same was found to be true in Lincoln's SOC (City of Lincoln, Nebraska, 2020). There was a disparity in the extent to which these reviews were occurring that seemed directly correlated with the specificity and veracity of a department's available data. On a fundamental level, Rogers (personal communication, January 27, 2020) and Moore(personal communication, January 30, 2020) stated explicitly that incident counts play a significant role in setting risk reduction priorities. Powers (personal communication, January 28, 2020) explained that in addition to standard information contained in an NFIRS report, his department was able to capture time stamps for several on-scene benchmarks. Lincoln and Hartford both reported on several different types of save and loss data in their SOCs (City of Lincoln, Nebraska, 2020) (Hartford Fire Department, 2019), as did the presentation provided by Rogers (personal communication, January 27, 2020). Fagan (personal communication, January 28, 2020) discussed how analyzing both locations and ignition sources of fire incidents allowed his department to pinpoint significant risks in its service area. Bennett (personal communication, January 30, 2020) wrote about evaluating several different sources of incident data when determining where to focus his risk reduction efforts, implying that these data points are readily available. No one talked specifically about predicting future service demands.

The accreditation process marked the beginning of IFD's first sincere efforts at consistently and effectively assessing incident and performance data. Incidents were counted by class and category for the entire service area and individual station response areas (Indianapolis

Fire Department, 2019b). Response times were measured against NFPA 1730 (National Fire Prevention Association, 2019b) standards (Indianapolis Fire Department, 2019b). A standard operating procedure for calculating save and loss data for property and contents from fire incidents was created to improve accuracy and consistency (Indianapolis Fire Department, 2020). Limiting factors included an inability to fully utilize RMS data due to issues with the program's reporting functions, inconsistent data quality, and the lack of a robust set of in-incident benchmarks. Each of these limiting factors can and should be addressed moving forward by working with the software developer, increasing training and accountability for company officers and chiefs regarding data input, and establishing mandatory, performance-based on-scene benchmarks. A system needs to be developed or obtained to easily capture these data points so that they can be easily assessed.

The literature review suggested several different demographic and socio-economic factors to consider while looking for vulnerable and at-risk populations. Augustin (2017) spoke to the importance of identifying areas with high percentages of homes where English is a second language. Huang (2009) noted that areas with lower rates of owner-occupied homes had a higher rate of fire incidence, and Istre et al. (2001) posited that poverty rates were also positively correlated to fire incidence and negatively correlated to injury and fire safety education levels. Age groups were also found to be a valuable predictor of service demands (Ahrens, 2013) (Federal Emergency Management Agency, 2017a). Other suggestions included those found in Table 1. While studying this data on the service area level is worthwhile, the real benefit comes when this information is assessed at the neighborhood or station response area levels. This specificity of analysis is a necessary component to moving from identifying the vulnerable populations to those specifically at-risk for and during particular events.

Each department reviewed was also utilizing demographic and socio-economic information to some degree. Powers (personal communication, January 28, 2020) spoke directly to monitoring real estate and census date regarding homeownership. He (J. Powers, personal communication, January 28, 2020) and Freeman (personal communication, January 27, 2020) both commented on the connections between poverty levels, service demands, and the need for risk reduction efforts. Powers (personal communication, January 28, 2020) and Fagan (personal communication, January 28, 2020) also discussed the connection between the prevalence of specific age groups in an area and the types of incidents that occur there. All of the SOCs reviewed went into great detail regarding demographic and socio-economic data on both the service area and geographical planning zone levels (City of Lincoln, Nebraska, 2020) (Hartford Fire Department, 2019) (Indianapolis Fire Department, 2019b).

IFD's (2019) CRA-SOC examined 15 census data points pulled from the entirety of Marion County. The study found that almost all of the statistics used to predict service demands suggested an elevated need compared to national averages (see Table 2). Poverty, unemployment, and crime rates well exceeded national norms (see Table 2). However, IFD's service area is large and extremely diverse. A breakdown of this data by station response area found pockets of concentrated poverty and negative economic indicators (Indianapolis Fire Department, 2019b). It also uncovered two station areas where close to one-third of the population primarily speaks Spanish (Indianapolis Fire Department, 2019b). These findings suggest a need for a robust CRR staff and point to areas of the city where programs will likely be needed. With the exception of a need for a Spanish-language outreach program, the specific types of programs needed have yet to be identified.

Analyzing either census or incident data is valuable in its own right, but the real benefit comes from melding the two together (Sowers, 2019). With the locations of the vulnerable populations established, departments can overlay incident data to discover which types of incidents are plaguing an area, as well as evaluate save and loss information (Martin, 2016). Ideally, NFIRS data should provide detailed, supplementary data on fire and EMS incidents such as who, what, where, when, and how (Augustin, 2017) (Criddle, 2019). Examples of this information would include noting if a fire was incendiary, and if smoke alarms were present and functioning (Augustin, 2017). For EMS incidents, injury types and mechanisms of injuries could be studied (Sowers, 2019), as was done in Denver (Nassel, et al., 2014). The analysis produced from studying this data will only be as valid as the data it is leveraging. Census data is rarely available in real-time. Most departments do not provide the necessary training or oversight to ensure their incident reports are accurate or sufficiently detailed (Gilcrease, 2019).

Not surprisingly, the practice of layering and cross-referencing data was prevalent among those interviewed and the departments studied. Powers (personal communication, January 28, 2020) stated that blending incident data with socio-economic information at the neighborhood level was both crucial to providing genuinely community-specific risk reduction efforts and a practice his department employs. The mySidewalk software Hartford utilizes is designed to specifically handle the task of melding data and providing analysis on a block-by-block basis (R. Freeman, personal communication, January 27, 2020). Fagan's (personal communication, January 28, 2020) example of Lawrence's dumpster fire initiative was a product of blending different information sources to identify a risk. Bloomington uses this approach to focus the majority of its risk reduction efforts on where they will be the most impactful (J. Moore, personal communication, January 28, 2020).

IFD's initial attempt at layering incident response data with demographic and socio-economic information left a fair amount to be desired. The incident data was easily broken down and counted by class and category, but three problems remained. First, the station response areas did not coincide with census blocks or tracks (Indianapolis Fire Department, 2019b). Second, information on census blocks and tracks were not included in the CAD's incident data (Indianapolis Fire Department, 2019b). These two issues meant that a genuine one-to-one relationship between incident data and census data would be virtually impossible. The third issue pertained to the lack of specificity regarding information about the incidents as the department was forced to use CAD data rather than incident report data from the RMS. The use of CAD data meant that information on injury types, causes of fires, and victim information was not easily able to be studied on a granular level. The addition of census tract and block numbers to the incident data stored in the CAD (a goal expected to be achieved by the end of 2021) will go a long way toward allowing the department to marry its response data with census data and other data sources (Indianapolis Fire Department, 2019a). As previously discussed, improvements are also being made towards the quality of the department's reporting and ability to produce meaningful reports out of the RMS. These changes will hopefully allow Henderson to learn the top 10 injuries in each station response area, as she would like.

Keeping in mind that the departments covered by this research are all either accredited through CPSE or currently pursuing accreditation, it is safe to say they are on the progressive end of the fire service as it pertains to performing community risk assessments. Even then, each faces issues and challenges with capturing and evaluating all of the different data sets they would like to consider. Also, these are all career departments with considerable resources. If they are having these issues, smaller departments are likely experiencing far worse. It would be

beneficial to develop an easily acceptable means for departments to share their approaches to collecting and analyzing this data on a national level by department size and type. Increased communication amongst the fire service, CAD designers, RMS software programs, and data analysis companies would also help to streamline these processes.

In addition to a department's incident information, Biggerstaff (2018) suggested also examining other agencies' data. Two such suggestions were the police indent reports and hospitals' emergency room data (Biggerstaff, 2018). Examining other agencies' data was found to be a fairly common practice among those interviewed. Hartford utilized mySidewalk's to draw information from several city entities (R. Freeman, personal communication, January 25, 2020). Bloomington accomplished a similar task by using Netage BV (J. Moore, personal communication, January 30, 2020). Fagan (personal communication, January 28, 2020) spoke of his department's push to build a data network involving the health department, public works, and police. Sharing data between agencies is a practice departments nationwide would undoubtedly benefit from, as would the agencies with which they are partnering.

These sharing efforts have only recently begun for IFD. Henderson has worked hard to create a strong network of partners with which the department works, but data-sharing efforts have been extremely limited. The recent breakthrough with Safe Kids Indianapolis is a promising start. Now that IFD can meaningfully analyze its incident data, it should work to build reciprocating relationships with other willing partners.

CPSE (2016) advocates breaking incident data down by class and category. This breakdown is based on an incident's probability of occurrence, the consequences it will have for the community, and the impact it will have on the department's ability to meet the community's other needs (Center for Public Safety Excellence, 2016). Calculating the impact should consider

the effective response force necessary to handle all of the critical tasks needed to mitigate an incident (Center for Public Safety Excellence, 2016). Each of the SOCs studied during this research utilized this model (City of Lincoln, Nebraska, 2020) (Hartford Fire Department, 2019) (Indianapolis Fire Department, 2019b). That said, each department's approach is unique, given that discerning consequence is mainly subjective and critical task analyses can resulted in slightly different outcomes from department to department.

Another suggestion repeated in the literature review was for departments to seek out partnerships with other agencies and external stakeholders. With a community risk assessment in-hand, departments should seek out other entities that have an interest in addressing the identified issues (Schaenman et al., 1990). For instance, the police and local mission charity may be willing to join resources and efforts towards addressing issues facing the homeless in a city. Working together to tackle the community's issues allows for multiple perspectives to be considered, decreases the likelihood of redundancy of effort, and allows for the group to leverage the strengths of each member while spreading the responsibility around. Other groups to be contacted include advocates and representatives for the underserved and minority populations within the service area (Augustin, 2017). Working directly with these groups will provide valuable insight into the needs and perceptions of these communities regarding the fire service (Augustin, 2017). It should also increase buy-in and participation within these groups (Augustin, 2017).

There were only a handful of mentions regarding partnering with external groups throughout the research interviews. It is worth noting that such programs were not inquired about by the researcher during the interviews. Fagan (personal communication, January 28, 2020) discussed developing public campaigns with other agencies. Bennett (personal

communication, January 30, 2020) specifically talked about considering whom his department could partner with to address community risk issues, how to increase their buy-in and participation, and utilizing these techniques to ensure the project remained under budget. IFD has been successful at building strong relationships with other city agencies and community partners in the past. As the focus of CRR programs become more targeted, the department should be able to leverage these relationships in powerful ways, increasing the benefits to the community and allowing the department's limited CRR resources to be utilized to their fullest.

Tracking the cost of programs (Augustin, 2017), developing a hazard database (Ludwig, 2016), and utilizing a database dedicated to tracking CRR information (Gudie, 2010) were also ideas explored in the literature review regarding building a community risk reduction approach. Aside from Bennett, Lincoln's strategic plan mentioned goals regarding the cost of services per capita and maintaining worker's compensation claims below 3.5 percent of the annual budget (City of Lincoln, Nebraska, 2020). Both Freeman (personal communication, January 27, 2020) and Moore (personal communication, January 30, 2020) discussed how their software tools allow their departments to keep track of hazards in their community in close to real-time. There were several examples of how departments are tracking their CRR outputs and a few examples of the outcomes being measured. No one specifically discussed using a dedicated system to track all of their CRR information in one place.

One of the projects taken on by the IFD's Planning Office is to perform a unit utilization study for the entire department (Indianapolis Fire Department, 2019a). As part of this process, CRRB will receive a significant amount of attention. The goals of the study include deducing the number of workhours needed to deliver each public education program and learning how inspector experience and occupancy-size impact inspection workloads. Efforts will be made to

discern the baseline workload of the department's fire investigators and to figure out how many hours a typical case demands. This information, along with CRRB's already detailed records on the costs of materials and program production, will allow the department better to understand the full cost of its CRR efforts. Over time, this information will allow the department to make better-informed decisions regarding which programs to pursue and which ones to shutter. As outcome metrics are improved, these studies will eventually allow the department to conduct detailed return-on-investment (ROI) calculations (Robertson, 2002). ROI figures should prove valuable when defending budget requests. As such, tracking the cost of its programs and assessing the ROI should be an area of greater focus for all departments.

With the specifics of why and how to perform a community risk assessment thoroughly discussed, the final area of this study's research and review is concerned with program development and assessment. Byrnes (2019) stated that the value in assessing CRR programs is to ensure they have the intended effect and that they are worth repeating in the future. Assessments should be performed early and often so that the program does not run for long periods before necessary course corrections are performed (Thompson & McClintock, 1998). Each program should have clear objectives and well-defined baselines and benchmarks (Thompson & McClintock, 1998). However, attempting to perform assessments that exceed tracking basic outputs can be challenging (Gerald, 2019).

Vision 20/20 (2018) suggests using four different evaluation types: formative, process, impact, and outcome. Formative evaluations are used to determine which programs are needed, decide upon program content, and to choose materials and delivery styles (Vision 20/20, 2018). Data collection tools should be tested and assessed, and, whenever possible, both target and control groups should be utilized (Ta et al., 2006). Everyone interviewed stated they were using

formative (data-driven) evaluations to determine the types of programs to provide. Hartford, Lincoln, and Indianapolis each had strategic plans with SMART goals included (Hartford Fire Department, 2018a). Powers (personal communication, January 28, 2020) and Fagan (personal communication, January 28, 2020) followed the advice given by Moriguchi (2015) to include social media campaigns and external partnerships when developing and rolling out new programs. Bennett (personal communication, January 30, 2020) discussed periodically evaluating his programs to identify what went according to plan and what needs improvement. No one reported utilizing CRR JPRs (Cass, 2017) or control groups, but the researcher found these concepts compelling.

Process evaluations are concerned with how the programs are implemented. These evaluations include tracking the number of times a program is presented, the number of people contacted, and the total cost of a program in terms of both funding and resources (Augustin, 2017). Measuring workload and costs were not discussed very often in the researcher's interviews, aside from the previously discussed efforts of Telluride (J. Bennett, personal communication, January 30, 2020) and Lincoln (City of Lincoln, Nebraska, 2020). Again, this is an area that IFD will be exploring over the next few years, and one that is recommended for further investigation by the fire service as a whole. Measuring outputs, such as the number of times a program was presented and the number of people reached, was prevalent among those surveyed. Powers (personal communication, January 28, 2020), Freeman (personal communication, January 27, 2020), and Rogers (personal communication, January 27, 2020) all discussed tracking this information. Powers stated his department reviews it every quarter, while the others do so each month. Fagan (personal communication, January 28, 2020) said Lawrence evaluates its data on an annual basis. For its part, IFD reviews an extensive list of outputs

(inspections, violations found and corrected, and public education programs by age) each month as part of its series of executive staff meetings. These reports provide an opportunity for improvement, catalyzing discussions on how to improve, rather than just report, on past performance.

Impact evaluations seek to measure the change in knowledge, skills, and attitudes after being exposed to a program (Vision 20/20, 2018). Impact evaluation tools include before and after surveys (Criddle, 2019), pre- and post-tests (Gudie, 2010), and practical skill assessments (Vision 20/20, 2018). Harrison (2015) suggested utilizing informal assessment techniques such as asking the students to finish an instructor's sentence or verbally summarize the main points of the program. These are particularly useful approaches when working with older adults (Harrison, 2015). While there were no mentions of utilizing before-and-after surveys during the interviews, Moore (personal communication, January 30, 2020) discussed how the use of pre- and post-tests allowed Bloomington to realize their fire and safety education efforts were not impactful for students until they reached the second grade. The researcher assumes that there is a practical component to the high school CPR program Rogers (personal communication, January 27, 2020) spoke of in his email. Henderson (personal communication, February 11, 2020) has long used pre- and post-tests to determine if children are receiving the intended messaging and lessons. Where the department could improve is in building a database where program effectiveness could be tracked and measured over a long period. This information would also come in handy when compared to future outcome data regarding the target audiences.

The last form of evaluation mentioned by Vision 20/20 (2018) is outcome evaluations. These involve studying changes in behavior, incidence occurrence, and results (Byrnes, 2019). They can be performed using either qualitative or quantitative measures (Byrnes, 2019).

Qualitative evaluations often come in the form of a story from an incident victim or program graduate who shares how a specific program altered their behavior and affected the outcomes they experienced (Byrnes, 2019). The most common examples of quantitative outcome measurements examine the change in the number of incidents after a program has been performed. For example, a program concentrating on improving code enforcement will likely measure the change in the number of fire incidents in inspected occupancies and the save and loss totals from before and after the program's implementation (Vision 20/20, 2018). A public CPR program may track the change in the percent of time bystander CPR was initiated before emergency crews arrived and the difference in outcomes when this occurred (Vision 20/20, 2018).

Powers (personal communication, January 28, 2020) shared an example from his department. Cross-analyzing incident and census data uncovered an issue within certain areas where older residents were experiencing a high number of fire-related injuries. These areas were then targeted with specific education programs. After the program had been presented, the reports from all fire incidents in the targeted areas were monitored. While a quantitative difference could be easily seen in the reduced number of injuries, Powers said the real value came from interviewing the reporting officers and residents. Going directly to the people most affected provided an opportunity for each to share how the program had impacted their outcomes. These messages could then be shared both internally and externally to improve morale and support for the department's efforts.

No one provided better examples of quality qualitative outcome measures than the Lincoln Fire and Rescue Department. Their strategic plan is full of SMART goals with specific benchmarks (City of Lincoln, Nebraska, 2020). These are then tracked on a monthly and annual

basis. They measure the growth rate of fire incidents against the growth rate of the population to determine if things are getting better or getting worse. Fire ground performance is measured by the percent of the time the fire escapes the room of origin, tracking civilian and firefighter injuries and deaths, and measuring what percent of the time entrapped victims are removed within ten minutes of alarm receipt. They measure EMS performance by tracking their ROSC rates as compared to national averages and how soon they are providing ALS and BLS care (outcome-based when used to assess their response model, not patient outcomes). They assess the value they provide to the community by monitoring workers' compensation costs against a benchmark of 3.5 percent of their budget, comparing cost per capita of service provision to comparable departments in their region, and seeking to save at least 95 percent of all property and contents in each fire.

IFD's current strategic plan marks its first attempt at utilizing outcome-based assessment measures (Indianapolis Fire Department, 2019a). Previously, outputs such as response times, public contacts, and occupancies inspected were the only measurements of program success. These did little in the way of assessing if the department's efforts were impactful. Over the next five years, the department will be striving to reduce the number of working fires, increase the percent of property saved in each fire, and reduce the property value lost each year on average as compared to the baseline average (Indianapolis Fire Department, 2019a). These SMART, outcome-based goals are great first steps and should be built upon in the future. Each program should have a clearly stated purpose and tied to a specific, if not unique, outcome-based metric.

To be clear, all four forms of assessments are valuable for every program. Careful thought and consideration need to go into how a program is constructed. The goals and desired outcomes must be determined in order to inform the selection of topics, materials, and strategies.

These then need to be assessed continuously to ensure there is still a need for the program and that the methodology and content are still relevant. Before one can expect to see changes in behavior, the treatment (program) must be received. It is vital to track outputs in order to clearly understand who has been reached, which messages have been shared, and what impact has occurred regarding knowledge, skills, and attitudes. Only at this point, when a well-constructed message has been delivered to the right groups in an effective manner, can one expect to see changes in behavior and incident outcomes.

One issue at IFD that became apparent through the course of this research was the existence of information silos. Both Henderson and Rowland (personal communication, February 11, 2020) claimed they had never received incident information beyond monetary save and loss data from fire incidents (it is unclear if that information came from the Operations Bureau or the Fire Investigations Unit). Now that the Planning Office has assumed responsibility for processing incident data, this problem should be easy enough to remedy. The existence of this problem, though, suggests that efforts should be made to check for similar informations throughout the department.

The next level of outcome measurement involves the consideration of secondary outcomes. An example of this would be measuring the cost of a business being shut down for an extended period after a fire incident. Beyond the cost to repair or replace the structure, equipment, and inventory, the lost potential revenue must be considered, as does the business's employees' lost wages. Both of these losses will also affect the tax base in the following year. The question becomes, how far out does one extrapolate these impacts? Are the impacts on the transport company considered? Should the loss in potential sales at the eventual retailer be counted? Are the benefits to the construction and manufacturing businesses involved in the fire

structure's rebuild accounted for in the totals? How about the increased business received by the affected business's competitors? Developing a uniformed and repeatable approach to calculating these impacts is both the Holy Grail for selling the value of community risk reduction efforts and the Rosetta Stone for allowing this approach to be shared industry-wide.

Recommendations

Per the results of both the literature review and research, IFD's CRRB is on the right track regarding the census and incident data it wishes to include in a community risk assessment. The list of requested human-related census data points consisting of information on age, race, ethnicity, and low-income families should be further supplemented with the data points captured in IFD's CRA-SOC (see Table 2). Additional consideration should be given to the population growth rate, education levels, homeownership rates, and transient populations. Other departments that are considering performing a community risk assessment would be well served to use all of the data points discussed above as a starting point.

CRRB should work with the EMS Division's quality assurance and continuous quality improvement program to identify which data points are currently available and which would be most beneficial to identifying community risk and vulnerable populations. CRRB should also meet with the Planning Office to establish the specifics of the reports they would like to receive and how often they would like to receive them. Finally, CRRB should work with the Health and Safety Division to gain access to information on fire-related firefighter injuries. Again, most departments would be well served to consider the fire and EMS incident data points mentioned here when beginning a risk assessment.

Census tract or block information must be added to each incident record in the CAD and RMS. Without one of these location data points, it is challenging to tie incident data directly to

census data. Within IFD's information technology (IT) systems, developing the ability to layer different data sets in this manner is crucial to pinpointing issue locations and vulnerable populations. These discoveries are critical to developing targeted interventions. The results of these efforts could be further enhanced by also layering the data acquired from other agencies and external partners gained through reciprocation agreements.

IFD needs to improve the quality of its incident data and learn how to leverage its RMS's reporting capabilities better. Improving the quality of data entered by company officers will require clear messaging on the potential benefits to the department, dedicated NFIRS training, and a quality assurance program. Improving the utility of the RMS program will first require discussions with the software provider, where the needs of the department are explained. These needs should be based on the requests of the Operations Bureau, CRRB, Health and Safety Division, and Planning Office. After any adjustments to the program have been made, IFD's IT training and Planning Office personnel should receive training directly from the software developer.

In addition to tracking the number of inspections and violations found and corrected, CRRB should continue to develop and apply its new methodology for assessing occupancy risk levels (see Appendix H). CRRB should work with the Operations Bureau and Planning Office to create a list of the most critical economic, historical, and cultural assets within the service area. Consideration should be given to categorizing these locations as high-risk due to the consequences of their potential loss. All high-risk and large-loss potential occupancies should receive annual inspections, pre-incident planning, and site-specific safety education. With these changes in mind, a reexamination of the service area's infrastructure may be warranted to identify any issues with providing service to the high-risk occupancies.

IFD needs to take a more significant role in developing the county's multi-hazard plan. As part of the department's involvement, resources should be dedicated to creating and delivering education regarding preparedness and resiliency techniques for at-risk populations. Plans need to be developed and practiced to ensure the needs of these groups are met during disasters. The research suggests that the development and delivery of disaster preparedness training is an area in which most departments could improve.

Based on the findings of the data reviewed in this research, there is a significant need for fire and safety education in the urban parts of the service area. Programs designed to increase the use of child car seats and booster seats are also warranted based on data provided by Safe Kids Indianapolis. The presence of a large Spanish-speaking population in the city, specifically in Station 18 and Station 33's response areas, suggests the need for the department to supplement its social media and education materials with Spanish equivalents. While there are other areas that the data suggests IFD should further investigate, this will be difficult until the census tracts are added in the incident records and the RMS system can report out on more granular information (such as type of injury and ignition sources). The department should focus on addressing the broader issues noted above while feverishly working to solve the problems that are precluding a more targeted approach.

When developing programs, CRRB needs to continue its recent trend of focusing more on local data than national trends. All programs need to be assessed in terms of the community's prioritized needs, the program's ability to be impactful, and the program's ROI. No programs should be viewed as "sacred cows." If, after both quantitative and qualitative assessments have been performed, a program is found to be inconsequential to the community's overall risk levels,

resources should be moved to where they can provide greater utility. Focusing on local data is sound advice for all departments.

There are a handful of other recommendations for all departments regarding CRR program creation. Each program should include a detailed explanation of the purpose it serves, the outputs (with benchmarks) that will be monitored, and its desired goals and outcomes. When it is both ethical and appropriate, the use of control groups should be explored. Control groups provide valuable insight into the efficacy of a program. Another avenue to explore is the creation of JPRs for CRR programs. During the formation of a program, the program's necessary skills and techniques should be identified and developed. Those responsible for program delivery should demonstrate mastery of these skills and techniques, both initially and periodically.

IFD should continue to utilize process evaluation metrics. As each program should have a formal description of the output metrics that will be tracked, the results of these should be reviewed regularly (monthly in most cases). These reviews should involve discussions on why the outputs are what they are and how they can be improved. For now, CRRB should review each program to ensure that output metrics are in place and current. When possible, the output metrics should be reviewed in conjunction with the program's outcome metrics. Unit utilization studies for each program, along with detailed records regarding material expenditures, will fully allow the department to understand the cost of producing a program. These approaches are proper for all departments and supported by the methodologies found in Vision 20/20 (2018).

Regarding impact evaluations, CRRB should continue its practice of providing pre- and post-tests to students receiving fire and safety education. Further opportunities to incorporate these tests and before-and-after surveys should be explored. Ideally, efforts would be made to

track changes in knowledge and attitudes over long intervals to discern how long the changes last. It is recommended to create a means to track and store all information concerning CRRB programs' process and impact evaluation measures. A more extensive database, maintained over a significant period, will provide previously unavailable insights into program design and effectiveness.

Every service program within IFD should be regularly assessed with outcome-based metrics. Program performance should be measured against baselines and include benchmarks. Care should be taken to ensure that the difference between outputs and outcomes are distinguished. Performance should be reviewed at the bureau and executive staff levels monthly.

The critical outcome metrics for the Fire Safety Inspection Program to track would be the change in the number of fire incidents, the change in the percent of property loss per fire incident, and the change in dollar value lost from fire incidents. The researcher agrees with Rowland (personal communication, February 11, 2020) when he says that added value comes from examining these statistics by occupancy type and use. Other telling comparisons would involve examining changes in the number of fire incidents and the dollar-loss caused by occupancy fires that occurred within 3, 6, and 12 months of the occupancy's most recent inspection. Monitoring the change in fire-related injuries to both firefighters and civilians also provides value. To some degree, tracking the change in the number of violations found would provide feedback on the quality of both the inspection and public education programs.

Public education lends itself to many outcome-based evaluations. A great metric to track would be the number of fire-related injuries occurring in occupancies that have received site-specific safety programs versus those locations that have not. Cross-referencing the schools who are fire drill compliant with those who are not regarding the number of fire-related injuries and

false alarms may show value in program participation. For each specific safety program, the outlined goals and metrics should be tracked in terms of both the predefined outputs and outcomes. The outcomes should be compared with control groups or pre-treatment data. For example, a program designed to increase child vehicle safety may track outputs of how many car seats were given away and installed, but the program's outcome will be measured by comparing injury data from before and after the its implementation. There may be multiple outcomes to track for a program, and a desired outcome may be pursued through multiple programs.

After a great deal of internal debate eventually led to no metrics being reported monthly by the IFD Fire Investigation Section in 2019, this subject needs to be revisited. Arson cases, arrests made, convictions, and case closure rates need to be tracked. While it is acknowledged that these statistics are neither totally under the department's control or indicative of performance, they provide the opportunity for year-to-year comparisons. Tracking hours per investigation would also provide insight into the staffing needs of the section. Further research on how other departments measure their investigation programs' performance is warranted.

IFD already has a handful of outcome benchmarks in place for its Operation Bureau. The department would greatly benefit from capturing additional on-scene benchmarks in either the CAD or RMS data such as water-on-the-fire, primary search complete, and loss-stop. These outputs could then be used to explore the reasons behind the outcome results regarding the percent of property saved and changes in fire loss totals. The measuring of response times could also be used in this regard, as well. Departments could study to see if there is correlation between response time and the fire being contained to either the room or floor of origin. A plan to capture these additional metrics should be formulated with involvement from the frontline

personnel, company officers, battalion chiefs, telecommunicators, IT staff, software developers, and administration.

Outcomes for the EMS Division should include monitoring the department's ROSC rate and paramedic performance and outcomes of ALS interventions. If the department began tracking time to patient and time to transport, this data could be cross-referenced with patient outcomes to gain a clearer picture of performance. Gaining the ability to query RMS data by injury type would also be a significant improvement. As the quality assurance and continuous quality improvement program continues to develop, this conversation should be revisited.

Recommended outcome evaluations for the Health and Safety Division include tracking the change in the number of on-scene injuries, percent of firefighters who required exercise prescriptions as a result of their annual physical fitness evaluations, and the number of department vehicle accidents. The injuries and accidents could be broken down even further to identify the causes, locations, and personnel most often involved. Outcome measures for the firefighter wellness and support program need to be further explored.

IFD's communication center and emergency management responsibilities are overseen by the same position. Outcome measurements have been found to be difficult to produce for these programs. That said, tracking call volume by time of day and changes in the 90th percentile times for alarm receipt and call processing would be valuable information to know when making decisions on staffing and training. Other potentially valuable statistics to know would be the percent of the time the original incident type is different from the final incident type, which initial incident types are most often changed, and which final incident types most often begin as a different initial incident type. Due to the nature of emergency management, discussions are needed to determine appropriate outcome measures. Potential output measures could include the

number of emergency preparedness programs performed, emergency preparedness packages disbursed, and how mand hours of multi-agency emergency event training have been performed.

The recommendations for the rest of the fire service mainly follow those made for IFD. Firefighter health and safety concerns need to be considered when building risk reduction plans. The area's emergency management director should play a role in the community risk assessment process and risk reduction program development. Departments should work to build relationships with other agencies and external partners with which they can share data and resources. Agencies should cross-reference data from all available sources, particularly census and incident data, to identify the groups and areas facing the highest levels of risk (the more site-specific, the better). It is recommended to look for correlations between different data points and service demands to predict future service demands in other areas; for example, studying the service demands in an area where several properties have been revitalized in recent years may be beneficial for predicting changes in service demands as other neighborhood begin similar changes..

A department's ability to utilize outcome-based assessments will largely depend on the quality and specificity of the data at their disposal. The key is to begin with clearly stating the program's goal. Departments should then brainstorm ideas for how the goal would manifest itself in the form of data. These ideas are then vetted for utility and to ensure the necessary metrics can be captured. With the end in mind, the program should then be developed by utilizing input from a variety of sources, both from within the department and its external partners. As the curriculum, materials, and delivery methods are decided upon, so too should the output metrics be chosen. The evaluation of the program's content and delivery method should begin soon after the program is first implemented and continue indefinitely. These evaluations

can be done through formal (surveys) or informal (conversations) means. Pre- and post-tests, surveys, and skill demonstrations can be used to determine if the intended changes to knowledge, skills, and attitudes are being achieved. If the program is well-designed, the result of these changes will manifest themselves by shifting the outcome metrics towards the intended benchmark levels.

There are a few areas the researcher would encourage future researchers to explore. First, should there be differences in the approaches to creating a community risk or program assessment when considering rural, volunteer, and combination departments? The most challenging, but also potentially the most valuable, topic to explore would be how to accurately assess the consequences of emergency events beyond the primary elements involved. For example, how does one calculate the total save and loss amounts for a factory fire that requires the business to be closed for an extended period? There are examples of departments working with companies to calculate their losses, but how many degrees of separation are relevant? Should the effects on the transportation companies which usually transport the factory's products be counted? How about the retailers who sell the products? Are the benefits to the companies involved in the remodeling or rebuilding also considered? How would all of these data points be captured and weighed? Clearly, there is much work to be done on this topic.

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Appendix A

2016-19 Indianapolis Fire Department Incident Response Data

Incident Code	Number of Calls	Percentage of Total
AB/BACK PAIN A CODE	13027	2.977348%
AB/BACK PAIN B CODE	1973	0.450933%
AIRCRAFT EMERGENCY	14	0.003200%
ALLERGIC REACTION A CODE	2623	0.599492%
ALLERGIC REACTION B CODE	52	0.011885%
ALLERGIC REACTION C CODE	6	0.001371%
ANIMAL BITE A CODE	599	0.136903%
ANIMAL BITE B CODE	85	0.019427%
ANIMAL BITE C CODE	1	0.000229%
APARTMENT ALARM	3910	0.893639%
APARTMENT FIRE	3055	0.698227%
APARTMENT FIRE W/ENTRAP	54	0.012342%
ASSAULT A CODE	4364	0.997401%
ASSAULT A CODE UNSAFE	4486	1.025285%
ASSAULT B CODE	624	0.142617%
ASSAULT B CODE UNSAFE	215	0.049139%
ASSAULT C CODE	36	0.008228%
ASSIST A PERSON	13791	3.151962%

BARN FIRE	21	0.004800%
BIOHAZARD	14	0.003200%
BLEEDING NON-TRAUMA A CODE	4650	1.062767%
BLEEDING NON-TRAUMA B CODE	401	0.091649%
BLEEDING NON-TRAUMA C CODE	4	0.000914%
BOMB THREAT	1	0.000229%
BUILDING ALARM	12340	2.820333%
BUILDING FIRE	1825	0.417108%
BUILDING FIRE W/ENTRAPMENT	6	0.001371%
BURNED PERSON A CODE	277	0.063309%
BURNED PERSON B CODE	57	0.013027%
BURNED PERSON C CODE	2	0.000457%
CARDIAC ARREST	9138	2.088509%
CHEMICAL SPILL INSIDE	19	0.004342%
CHEST PAIN A CODE	35155	8.034749%
CHEST PAIN C CODE	2	0.000457%
CO DETECTOR	2492	0.569552%
DBL RES W/ENTRAPMENT	13	0.002971%
DBL RESIDENCE ALARM	39	0.008914%
DBL RESIDENCE FIRE	668	0.152673%
DEPT PD ACCIDENT	450	0.102848%
DEPT PI ACCIDENT	8	0.001828%
DETAIL	29	0.006628%

DIABETIC A CODE	9266	2.117764%
DIABETIC B CODE	180	0.041139%
DIFF BREATHING A CODE	41276	9.433716%
DIFF BREATHING B CODE	15	0.003428%
DIFF BREATHING C CODE	1	0.000229%
DIVE - WATER RESCUE	162	0.037025%
ELEVATOR	1415	0.323401%
EMERGENCY TRANSFER	9	0.002057%
ENVIRONMENTAL A CODE	1044	0.238608%
ENVIRONMENTAL B CODE	79	0.018056%
ENVIRONMENTAL C CODE	1	0.000229%
EXPLOSION	27	0.006171%
FIELD FIRE	32	0.007314%
GARAGE FIRE	565	0.129132%
GAS MAIN RUPTURE	379	0.086621%
GAS ODOR IN BUILDING	791	0.180785%
GAS ODOR IN RESIDENCE	828	0.189241%
GAS ODOR MODIFIED	2	0.000457%
GAS ODOR OUTSIDE	709	0.162043%
GRASS FIRE	1347	0.307860%
GUNSHOT	603	0.137817%
GUNSHOT UNSAFE	1999	0.456876%
GYENCOLOGY A CODE	1271	0.290490%

GYENCOLOGY B CODE	108	0.024684%
HAZMAT WITH FIRE	7	0.001600%
HEAD INJURY A CODE	3432	0.784391%
HEAD INJURY B CODE	282	0.064452%
HEAD INJURY C CODE	29	0.006628%
HEADACHE A CODE	866	0.197926%
HEADACHE B CODE	132	0.030169%
HEADACHE C CODE	5	0.001143%
HIGH RISE APART ALARM	469	0.107191%
HIGH RISE APART FIRE	159	0.036340%
HIGH RISE APART FIRE W/ENTRAP	1	0.000229%
HIGH RISE BUILD ALARM	1803	0.412079%
HIGH RISE BUILD FIRE W/ENTRAP	1	0.000229%
HIGH RISE BUILDING FIRE	146	0.033369%
HIGH RISE HOSP/NURSING ALARM	577	0.131875%
HIGH RISE HOSP/NURSING FIRE	36	0.008228%
HIGH RISE SCHOOL ALARM	10	0.002286%
HIGH RISE SCHOOL FIRE	2	0.000457%
HOSP/NURSING HOME ALARM	1231	0.281348%
HOSP/NURSING HOME FIRE	123	0.028112%
HOSP/NURSING W/ENTRAP	1	0.000229%
INCOMPLETE CALL / BUILDING	9	0.002057%
INCOMPLETE CALL / RESIDENCE	16	0.003657%

INJURED PERSON A CODE	22780	5.206417%
INJURED PERSON A CODE UNSAFE	351	0.080222%
INJURED PERSON B CODE	4517	1.032370%
INJURED PERSON B CODE UNSAFE	13	0.002971%
INJURED PERSON C CODE	153	0.034968%
INJURED PERSON W/ENTRAPMENT	53	0.012113%
INVESITGATE SPILL	961	0.219639%
INVESITGATION	4832	1.104364%
LAWN MOWER FIRE	18	0.004114%
LOCK OUT - STRUCTURE	372	0.085021%
LOCK OUT - VEHICLE	1708	0.390367%
MEDICAL ALARM	8726	1.994346%
MEET LAW ENFORCEMENT	374	0.085478%
MENTAL EMOTIONAL A CODE	3322	0.759250%
MENTAL EMOTIONAL A CODE UNSAFE	3620	0.827359%
MENTAL EMOTIONAL B CODE	971	0.221924%
MENTAL EMOTIONAL B CODE UNSAFE	523	0.119533%
MENTAL EMOTIONAL C CODE	35	0.007999%
MOBILE HOME/TRAILER FIRE	47	0.010742%
MODIFIED COLLAPSE	667	0.152444%
MODIFIED RESPONSE	61	0.013942%
MODIFIED RESPONSE / BUILDING	22	0.005028%
MODIFIED RESPONSE / RESIDENCE	5	0.001143%

MOTORCYCLE PI	1616	0.369340%
ON-STATION	54	0.012342%
OVERDOSE /UNSECURE	2	0.000457%
OVERDOSE A CODE	15064	3.442909%
OVERDOSE A CODE UNSAFE	2984	0.681999%
OVERDOSE B CODE	387	0.088450%
OVERDOSE B CODE UNSAFE	36	0.008228%
OVERDOSE C CODE	24	0.005485%
PEDESTRIAN STRUCK	2298	0.525213%
PEDIATRIC CARDIAC ARREST	29	0.006628%
PERSON CHOKING A CODE	622	0.142159%
PERSON CHOKING B CODE	107	0.024455%
PERSON CHOKING C CODE	2	0.000457%
PERSON STABBED	325	0.074279%
PERSON STABBED UNSAFE	774	0.176899%
PI A CODE	23260	5.316122%
PI B CODE	2782	0.635832%
PI W/ENTRAPMENT	1299	0.296889%
PI W/ENTRAPMENT WORKING	3	0.000686%
POWER LINE DOWN	1427	0.326144%
POWER LINE DOWN NON-EMERGENT	48	0.010971%
PREGNANCY A CODE	3248	0.742337%
PREGNANCY B CODE	57	0.013027%

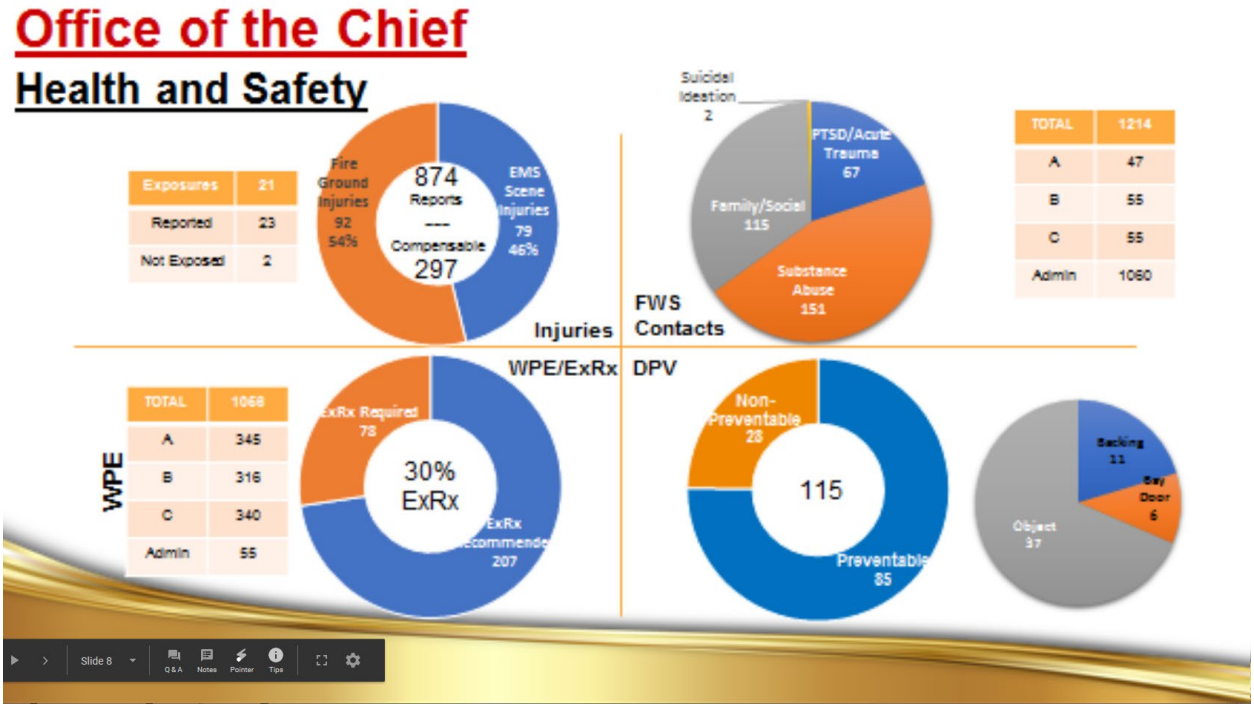
PROJECT LIFESAVER	26	0.005942%
RECOVERY	41	0.009371%
RESIDENCE ALARM	10313	2.357058%
RESIDENCE FIRE	5385	1.230753%
RESIDENCE FIRE W/ENTRAP	96	0.021941%
ROPE RESCUE	10	0.002286%
RV/SEMI FIRE	219	0.050053%
SCHOOL ALARM	926	0.211639%
SCHOOL FIRE	108	0.024684%
SEARCH AND RESCUE	29	0.006628%
SEIZURE A CODE	17884	4.087426%
SEIZURE B CODE	277	0.063309%
SICK PERSON A CODE	42581	9.731977%
SICK PERSON B CODE	4147	0.947806%
SICK PERSON C CODE	327	0.074737%
SICK PERSON FLU LIKE SYMPTOMS	93	0.021255%
SPILL - OUTSIDE, KNOWN, <5 GALLS	52	0.011885%
SPILL - OUTSIDE, KNOWN, >5 GALLS	122	0.027883%
STABBING	1	0.000229%
STABBING / UNSECURE	1	0.000229%
STANDBY	1	0.000229%
STROKE A CODE	7595	1.735853%
STROKE B CODE	469	0.107191%

STRUCTURE COLLAPSE	195	0.044568%
SWAT INCIDENT	76	0.017370%
TACITCAL PI	171	0.039082%
TANKER FIRE	2	0.000457%
TARPOT FIRE	2	0.000457%
TRAIN FIRE	5	0.001143%
TRASH FIRE	4832	1.104364%
TREE FIRE	399	0.091192%
TRENCH RESCUE	7	0.001600%
UNCONSCIOUS PERSON A CODE	36139	8.259644%
UNCONSCIOUS PERSON B CODE	281	0.064223%
UNCONSCIOUS PERSON C CODE	1	0.000229%
UNKNOWN CALL - EMS	1298	0.296661%
UNKNOWN CALL - FIRE	86	0.019655%
UTILITY POLE	1470	0.335972%
UTILITY POLE NON-EMERGENT	83	0.018970%
VEHICLE FIRE	2990	0.683371%
WATER INVESTIGATION	152	0.034740%
WATER RELATED INJURY A CODE	52	0.011885%
WATER RELATED INJURY B CODE	5	0.001143%
WORKING APART FIRE	2	0.000457%
WORKING BUILDING FIRE	3	0.000686%
WORKING CARDIAC ARREST	4	0.000914%

WORKING GARAGE FIRE	2	0.000457%
WORKING GAS MAIN RUPTURE	1	0.000229%
WORKING HIGH RISE APART FIRE	1	0.000229%
WORKING MOBILE/TRAILER FIRE	1	0.000229%
WORKING PEDIATRIC CARDIAC ARREST	1	0.000229%
WORKING RESIDENCE FIRE	11	0.002514%
#N/A	11	0.002514%
(blank)		0.000000%
Grand Total	437537	0.000000%

Appendix B

2018 Health and Safety Division Data



Appendix C

Community Risk Reduction Public Education Plan

Community Risk Reduction

Public Education

Assess the community's needs and effectiveness of programs

1. Develop a system to annually identify specific public education targets based on data and the CRA.
    - By September 31st of current year, will gather the prior full year's data, captured by IFD to assess the community needs. The following are the data points captured:
        a) Fire Data: number, location, type (residential/commercial), cause / origin, dollar loss/saved, and any fire detection/suppression/prevention equipment used, malfunctioned or absent.
        b) Fatality Data: fires with fatalities the following additional information is needed; age, gender, ethnicity of victim(s), and where they were located.
        c) Injury Data: number injured/incident, cause, type of injury, age, gender, ethnicity
    - Review CRA: Compare the data collected from IFD against data collected from the CRA. Evaluate for inconsistences, trends, and any new developing risk and risk areas. At the completion of the review, specific public education targets will be identified. Target completion date is October 31.
2. Identify and document all safety programs in the service area
    - Continue to update the Pub Ed Community Partners Excel spreadsheet to document safety programs being offered in our service area by community partners.
    - Search the internet for safety programs in our service area that are being offered by organizations/groups that are not already partnering with the IFD.
3. Develop assessment procedures for impacts of programs
    - Once we have completed the annual assessment of community needs. That information is then compared to the current programs being offered. Program Outcomes are developed and evaluated annually. If it is determined that current programs are no longer needed, resources will be reallocated to modify existing programs or create new programs to meet the community's needs.
    - Program impact is assessed as follows:
        i. Participant impact: Participants are assessed for knowledge gain through the use of pre and posttest.
        ii. Program impact: to evaluate the impact of our programs the following steps are completed:
            1. The results from the Pre and posttest are evaluated to makes sure program participants are receiving the information.

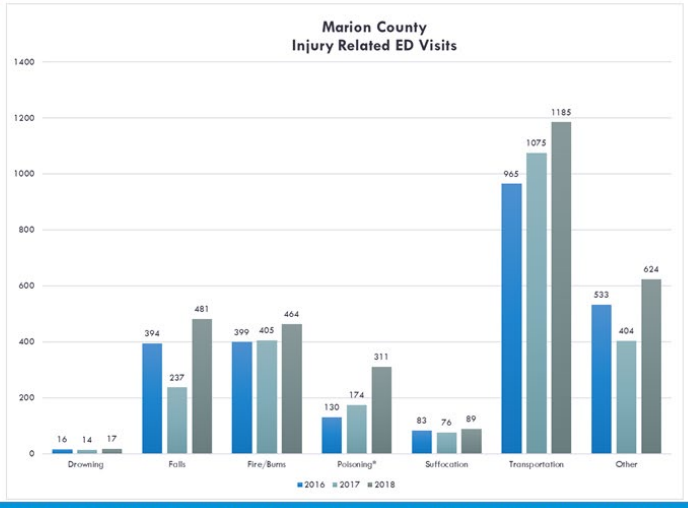
2. The program evaluations are reviewed to ensure proper program delivery. Programs are evaluated on how they are presented, the presenter and appropriateness for the audience.
3. The annual Fire Data, Fatality Data & Injury Data is evaluated against past years to determine if short and long term Outcomes are being met.

4. Develop educational programs to address high risk/loss potential.
   - Currently Public Education has two programs to address high risk/loss potential. Fire W.I.S.E (Fire Workplace Intervention Safety Education) educates local businesses about fire & life safety, evacuation and fire extinguisher training. F.L.A.M.E (Fire & Life Safety A Mature Education) goes on location to teach senior citizens about fire & life safety.
     i. Both of these programs were developed to address occupancies with the potential of large loss of life.
     ii. Curriculums for these programs were developed by a combined effort of educators using references such as the NFPA (National Fire Protection Association), USFA (US Fire Administration), NFSC (National Fire Safety Council), IFSA (International Fire Service Training Association), NFA (National Fire Academy) and other credible sources/training.
5. Develop an appraisal system for the juvenile fire setter program.
   - The IFD has an Excel spreadsheet where we document each person that enters our program. It tracks the participant from the time they enter the program, receive the intervention and complete the program. This total process takes 1 year. There is an assignment given, 3 month follow up, 7 month follow up and then a final 12th month follow up. At that point the participant is determined to have completed the program. If there is no return to unsafe fire behaviors the participant is recognized as having successfully completed the program.

Appendix D

Safe Kids Indianapolis Data

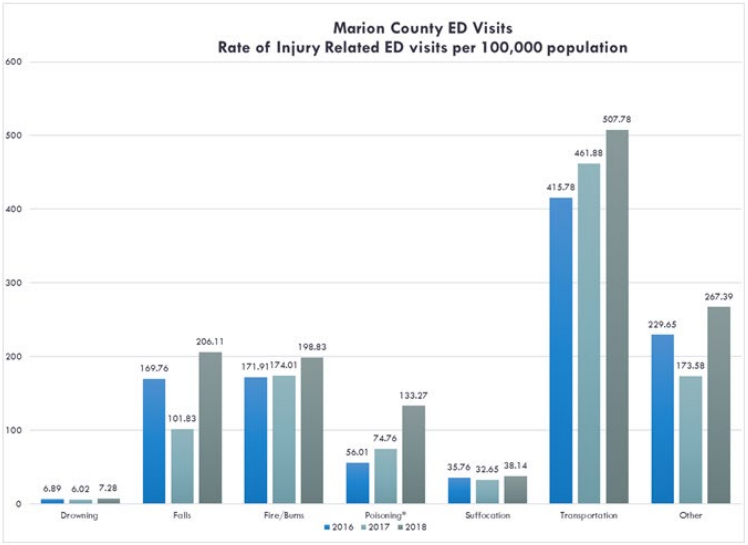
Marion County Emergency Department Visits Children 0-17



*ED visits labeled as poisoning contain overdoses. Intent cannot be determined based on ED record, so it could contain accidental and intention ODs. Other includes animal bites, accidental firearm discharge, etc.
Data prepared by Jennifer Zuker, MCPHD Epidemiology

4

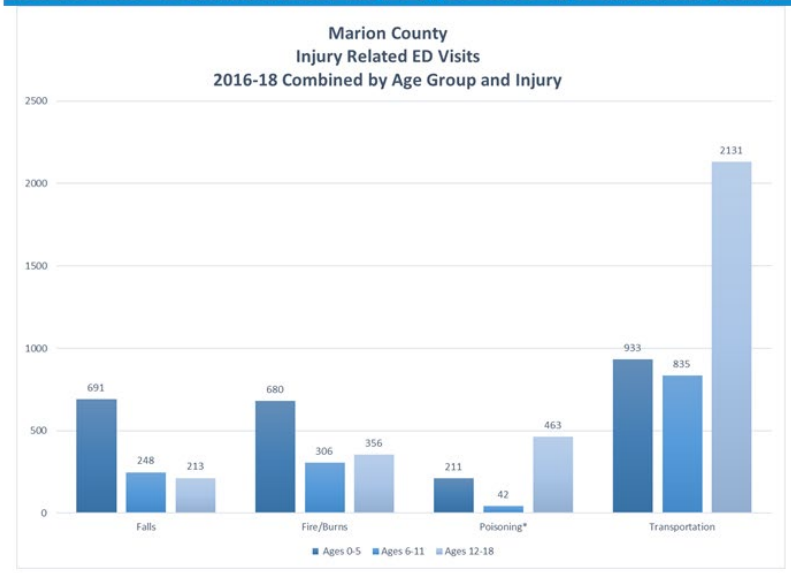
Marion County Emergency Department Visits Children 0-17



*ED visits labeled as poisoning contain overdoses. Intent cannot be determined based on ED record, so it could contain accidental and intention ODs. Other includes animal bites, accidental firearm discharge, etc.
Data prepared by Jennifer Zuker, MCPHD Epidemiology

5

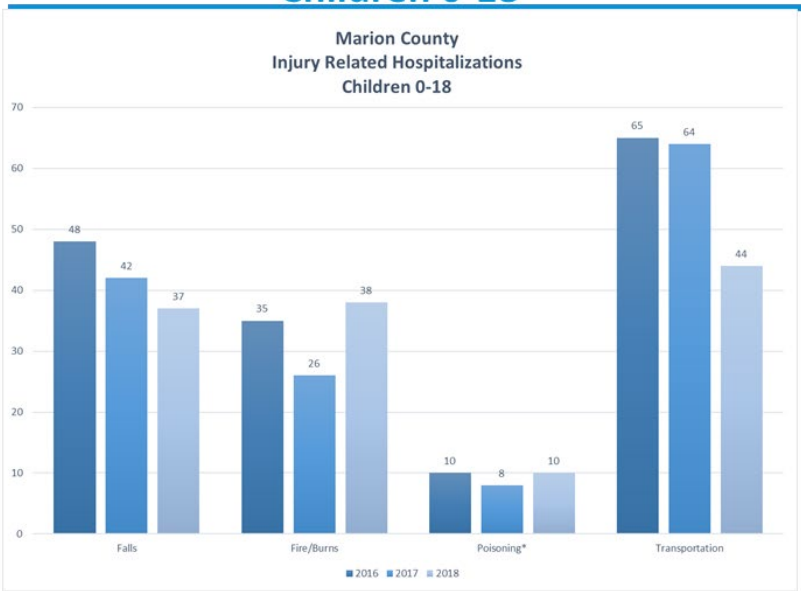
Marion County
Injury Related ED Visits
2016-18 Combined by Age Group and Injury



*ED visits labeled as poisoning contain overdoses. Intent cannot be determined based on ED record, so it could contain accidental and intention ODs. Other includes animal bites, accidental firearm discharge, etc.
Data prepared by Jennifer Zuker, MCPHD Epidemiology

6

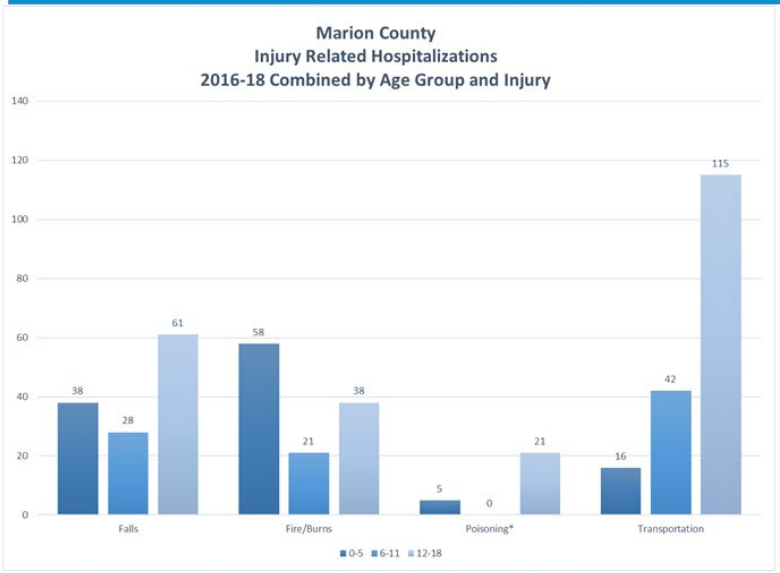
Marion County
Injury Related Hospitalizations
Children 0-18



*ED visits labeled as poisoning contain overdoses. Intent cannot be determined based on ED record, so it could contain accidental and intention ODs. Other includes animal bites, accidental firearm discharge, etc.
Data prepared by Jennifer Zuker, MCPHD Epidemiology

7

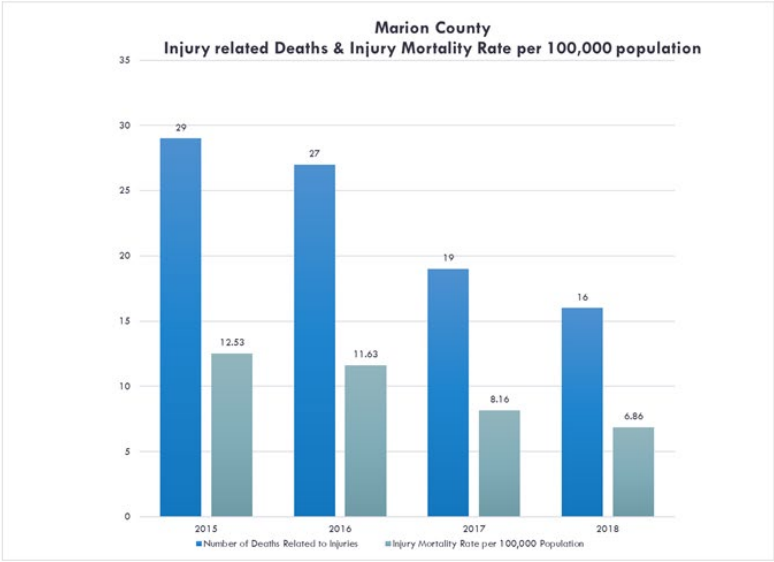
Marion County
Injury Related Hospitalizations
2016-18 Combined by Age Group and Injury



*ED visits labeled as poisoning contain overdoses. Intent cannot be determined based on ED record, so it could contain accidental and intention ODs. Other includes animal bites, accidental firearm discharge, etc.
Data prepared by Jennifer Zuker, MCPHD Epidemiology

8

Marion County Injury Related Deaths &
Injury Mortality Rate per 100,000 population
Children 0-17



All years combined-
91 deaths
9.79 rate per 100,000

9

Appendix E

Indianapolis Fire Department Public Education Programs

INDIANAPOLIS FIRE DEPARTMENT PUBLIC EDUCATION PROGRAMS

- **Brave Buddies –** Goes on location at daycares, schools, etc. to teach pre-k & Kindergarten Students, What's Hot and Not, the job of a smoke detector, the importance of calling 9-1-1 for help, and what they should do in the case of a fire! All is taught in a fun and interactive way.
- **Hero's Helpers** – Is essentially same program as Firehouse Friends except it is especially modified for Kindergarteners.
- **Firehouse Friends** – Survive Alive program that uses a life size village and state of the art equipment to simulate a house fire to teach 1st & 2nd graders how to escape a house fire, what to do if your clothes catch fire, Dangers of matches & lighters and lots more. (IMPD would partner to teach gun safety and stranger danger but no longer participates.)
- **W.W.F.D** – What Would Firefighters Do?- Goes on location to teach 3rd & 4th grade students about positive character building, disaster preparedness and fire and injury prevention.
- **Kidz-*in*-Charge –** Survive Alive program that uses a unique approach to educate 5th & 6th grade students as the fire safety leader of the home. It includes fire science, disaster preparedness, common hazards in the home, fire escape planning/training and Firefighter career awareness.
- **F.L.A.M.E.** – Fire & Life Safety A Mature Education – Goes on location to teach senior citizens about fire & life safety. Includes cooking safety, smoking safety, falls, smoke detector and evacuation education.
- **Fire W.I.S.E. –** Fire Workplace Intervention Safety Education - Educates local businesses about fire & life safety, evacuation and fire extinguisher training.
- **Keep It Safe Indy –** Link on IFD home page where the community can find safety information on different fire & life safety topics.
- **Safety Trailer Programs –** IFD offers 2 programs using our fire safety mobile home. Hunt for Home Hazards program, where participants have to quickly recognized some common fire & life safety hazards found in the home, and an E.D.I.T.H program.
- **C.O.M.E.T –** Community Outreach Mobile Education Truck – Promotes reading (distributes free books) and facilitates teaching a variety of topics based on the needs of the community.

- **Safe At Home –** Smoke alarm program where IFD conducts home visits to educate residents in fire safety and smoke alarm maintenance. Installations are conducted when necessary.

- **Car Seat Program –** Teaches parents and caregivers how to select the right seat, secure the child in the seat and how to make sure the seat is secured correctly in the vehicle.

- **Fire Stop Program –** Provides incident specific and age appropriate intervention through fire service, law enforcement, juvenile justice, mental health and or other social service agencies.

- **T.E.E.N.S. –** Participants learn the dangers of distracted driving. This is a very interactive program that encourages participation to elevate the learning experience.

- **Child Passenger Awareness for Providers –** This is a special program that provides child passenger safety awareness, education and training to healthcare providers, counselors and caregivers. This program does not provide a certification.

- **IN Safe Sleep Program –** This program reinforces the importance of prenatal care and safe sleep practices for infants.

Appendix F

2019 Indianapolis Fire Department Public Education Outputs

EOY TOTALS 2019	
Survive Alive - Kids (K-5 curr.)	1878
Survive Alive - Kids (other)	59
Survive Alive - Adults	901
Survive Alive - Total	2838
Pub Ed Kids (K-5 curr.)	19397
Pub Ed Kids (Pre-K)	3274
Pub Ed Kids (Jr. High/HS.)	18945
Pub Ed - Adults	19646
Pub Ed - 65 & over	579
Pub Ed - Total	61841
Pub Ed Exposure	233883
Car Seat - Appts	83
Car Seats - Given	40
Car Seats - Checked	40
Home Visits - Installed	168
Smoke Blitzes - Installed	644
Smoke Alarms Distributed	44
Total Impact (People)	966
Book Mobile # Events	3
Book Mobile Kids	97
Book Mobile Adults	33
Trailer # of Events	33
Trailer Kids	3739
Trailer Adults	2219
Fire W.I.S.E. (smoke simulator)	2400
Fire Stop Referrals	16
Fire Stop Interviews	3
FF Presentations #	32
Kids	2143

Adults	436
FF's Show & Tells	247
Kids	78165
Adults	60214
IFD Open House Events	712
Citizens Energy Mailing	441,500
	42
Total Educated by Pub Ed	73882
Total Educated by FFs	2579
Total Educated plus FF's show & tells	214840
Total with Exposures	449689
Grand Total with Citizen's Mailing	**891,189**

Appendix G

2019 Indianapolis Fire Department Fire Safety Inspection Outputs

KPI Report (2019)

Current number of inspectable Occupants
35,126
Number of inspections completed year to date
11,436
Percent of inspectable occupants inspected year to date
32.54%
Number of violations identified year to date
6,116
Number of violations corrected year to date
3,626
Total Number of years to date continuing education hours Inspection Division
498
Percentage of Deputy Fire Marshals **8** and Plan Reviewers **1** that have achieved over 24 hours of continuing education
100%

Stephen Rowland
Captain - Assistant Fire Marshal
Fire and Life Safety Division

Appendix H

Indianapolis Fire Department Occupancy Risk Assessment Matrix

Email dated December 5, 2019

Construction Type – Structure->Change to "Type I- (description of what Type I is)"
Scoring: Type I = 0; Type 2 = 3; Type 3 = 5; Type 4 = 8; Type 5 = 10

Square Footage – Occupant->Square Footage
Scoring: <3,000 = 0; 3,000-9,999 = 3; 10,000-29,999 = 6; 30,000-99,999 = 9; >100,000 = 12

Stories – Occupant->Top floor of occupant – (need a new data point for this or change an existing one like AED or suite number)
Scoring: 1 = 0; 2-3 = 2; 4-7 = 6; 8+ = 10

Structural Concerns – Location->Zone->Hazard Building
Scoring: None = 0; 1 or more hazard files = 3

Structural Concerns – Occupant->Status
Scoring: 0 open violations = 0; 1 or more open violations = 3

Structural Concerns – Portal->
Scoring: 0 reports in last year = 3; 1 report or more in last year = 0

Maximum Occupancy Load – Occupant->Max Occupant Load (sum of all rooms)
Scoring: <50 = 0; 50<100 = 3; 100<1,000= 6; 1,000<10,000 = 9; 10,000+ = 12

Distance to Water – Structure->Water Type (take Direct and Tank out)
Scoring: 0-500 ft to hydrant = 0; 500<1,000 = 3; 1000+ = 6

Hazard Classification – Occupant->Occupancy Hazard Class
Scoring: NFPA 1142 Class Rankings – 7 = 2 pts; 6 = 3pts; 5 = 4pts; 4 =5 pts; 3 = 6 pts

Single Use vs Multi-use – Structure->NFIRS Use Property Code
Scoring: Not mixed use = 0; mixed use = 5

Basement – Occupant->Bottom floor of occupant if below ground
Scoring: 0 underground floors = 0; 1st basement level = 3; 2nd basement floor = 6; 3rd or deeper basement floor = 10

Suppression Type and Coverage - Occupant -> Extinguishing System (we need to change it) (must add in fully or partially)
Wet pipe system, Foam system, Clean Agent system = 33; Dry pipe = 25; Type 1 = 15; Type 2 = 5 (needs to be regularly serviced); add 33 for fully and 17 for partially

Detection Type and Coverage - Structure -> Detection Type
smoke alarms 4, local smoke alarms and pulls 12, monitored smoke detectors 20, monitored smoke detectors and pulls 25, full alarm system 33 (still needs to be serviced)

Formula - Add the scores from construction type through basement to find the gross risk score for the occupancy (GRS).

Add the Suppression and Detection scores together to get the gross safety score (GSS). Divide the GSS by 100 to get the net safety score (NSS). Multiply NSS by .25; subtract this number from 1 to find the Final Modifier (FM).

Multiply the GRS by the FM to get the final risk score.

Stephen Rowland
Captain - Assistant Fire Marshal
Fire and Life Safety Division
Indianapolis Fire Department