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Mitigating Violence Against First Responder Teams: Results and Ideas From the *Hackmanathon*

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Abstract

First responders are on the front line of patient care and service, but research has shown that they are also on the front line of exposure to violence. Currently, there is a lack of evidence-based interventions that

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prepare first responders to handle violence on the job. With the increase in emergency medical services (EMS) call volume and reports of at least 57% of the EMS responders having experienced workplace violence, there is a need to develop scientifically systematic solutions to improve emergency responder safety. Using an adapted version of the hackathon method, academic scholars and practitioner conference attendees at the Interdisciplinary Network for Group Research (INGRoup) Conference were deployed into three multidisciplinary teams to analyze the issue and develop specific solutions. These solutions offer unique interventions to improve first responder safety.

Keywords
hackathon, emergency response, safety, multiteam systems, situational awareness

Violence is a major occupational challenge in the field of emergency medical services (EMS). Since the 1970s, violence against EMS responders has been recognized as an occupational hazard, and recent incidents indicate that the problem persists. In studies measuring career exposure to violence, between 57% and 93% of the EMS responders reported experiencing at least one act of verbal and/or physical violence (Bigham et al., 2014; Oliver & Levine, 2015). The extant literature describes verbal abuse, physical assault, and intimidation as the most frequently reported types of workplace violence in EMS (Bernaldo-de-Quiros et al., 2014; Boyle, Koritsas, Coles, & Stanley, 2007), with verbal violence described as the most prevalent form of violence (Gormley, Crowe, Bentley, & Levine, 2016; Rahmani, Hassankhani, Mills, & Dadashzadeh, 2012).

As EMS providers typically operate in teams and are embedded in a multiteam system (MTS; Lazzara et al., 2015), organized collaborative problem-solving is one way to potentially address the violence problem (Jewett & MacPhee, 2012; Li, Bingham, & Umphress, 2007). To help with the problem of violence and to respond to members of the Interdisciplinary Network for Group Researchers' (INGRoup) desire for the conference to be more interactive and interdisciplinary, a hackathon-style interactive and collaborative activity was introduced in 2017. A hackathon, also known as a hack day, hackfest, or codefest, is a *sprint*-like event designed for software projects in which computer programmers collaborate intensively with others involved in software development, including *graphic designers, interface designers, project managers*, and subject matter experts (SMEs; Briscoe & Mulligan,

2014). Modeled after the hackathon, INGRoup Conference organizers and leadership created the *Hackmanathon*, a hackathon intended to focus on a problem that may be solved using the science of groups and teams. This event was named in honor of a major figure in the field of groups/teams research who applied theory and problem-solving to address wicked problems involving groups: J. Richard Hackman.

This report on the 2018 Hackmanathon from the INGRoup Conference covers several aspects of the event. First, we provide a review of the problem and a brief acknowledgment of groups and teams science and collaborative problem-solving. Second, we describe in detail the hackathon procedures and present the three solutions provided by the three separate teams. Third, we reflect upon the solutions, identifying differences, and overlapping ideas, while linking the solutions further to team science. Finally, we conclude by reviewing the hackathon process in general, identifying opportunities for improvement, and encouraging scientists and practitioners to deploy this useful collaborative method. The main contributions are the potential for improved safety of emergency responders for those who deploy the proposed solutions discussed here, refinement of the hackathon procedure for the social science of groups and teams, and the continued development of the hackathon challenge as currently constituted and adopted by INGRoup.

Review of the Problem

As an entry point between the population and the health care system, the EMS system provides services to stressed communities and stressed patients. Approximately 900,000 paid and volunteer EMS responders treat an annual patient base of approximately 22 million in the United States (Maguire, Hunting, Smith, & Levick, 2002). There were 29 million calls for EMS in 2015, representing a 23% increase from 2014 (National Emergency Medical Services Information System, 2016). Major metropolitan fire departments have reported that more than 70% to 90% of their work occur in the EMS realm (National Fire Protection Association, 2016).

However, this growth is troubled by high rates of injury and fatality. The annual rate of non-fatal injuries among paramedics is five times higher than the national average for all workers (Maguire, Hunting, Guidotti, & Smith, 2005), and the annual rate of occupational fatalities among paramedics is two times higher than the national average for all workers (Maguire et al., 2002). In a retrospective cohort study of nationally registered emergency medical technicians (EMTs), assault was the cause of 8% of the fatalities (Maguire & Smith, 2013). With increasing demands for EMS s, responders are being placed at increased risk for experiencing violence from their patients (Lucas,

1999). A 2013 survey of 1,789 nationally registered EMTs in the United States found that 69% had experienced verbal and/or physical violence in the past 12 months (Gormley et al., 2016). Although verbal violence is the most prevalent form of violence experienced, 44% reported experiencing at least one form of physical violence over the same study period (Gormley et al., 2016). The extant literature describes the most frequent source of physical violence being *struck by* attempts (i.e., attempted forcible contact made by person or object directed at EMS responder), followed by punching, slapping, scratching, spitting, and biting (Bigham et al., 2014; Gormley et al., 2016; Mechem, Dickinson, Shofer, & Jaslow, 2002). Injuries incurred from violence include minor bruises, abrasions, contusions, hematomas, sprains and strains, eye injuries, facial injuries, bites, lacerations, dislocations, and fractures (Corbett, Grange, & Thomas, 1998; Mechem et al., 2002; Petzäll, Tällberg, Lundin, & Suserud, 2011).

Acts of violence experienced by EMS responders have been described as "struck by patient," "punched in the face by a drunkard," "tackled by a large man," and "assaulted by a combative patient" (Taylor et al., 2016). The team's EMS SME, Jill, expounded upon her first exposure to violence on the job:

> I responded to an intoxicated subject in the parking lot of a 7 Eleven one night. He was combative because he wanted to bring alcohol with him to the hospital and [the police] advised he could not [since he was not cooperating]. He got very loud with my partner, making threats in the back of the ambulance. I could hear it all while I was driving to the hospital until my partner yelled for me to pull over because the patient had jumped off the stretcher. He jumped out of the ambulance before I could completely put it in park. He ran away and we haven't seen him since because he didn't reside in our [response area] to begin with. That [call] could have gone differently and I'm glad it didn't. I genuinely fear going on a call and getting hurt or my partner getting hurt and me not being able to do anything about it other than press an orange [panic] button and hope for the best. I love what I do and it's sad that we have to watch our backs from the very people who call us for help sometimes. The publics' disregard for so much worries me. We just try to stay safe, keep that positive attitude, remain alert and do our jobs to the best of our ability.

To date, no evidence-based interventions exist to prepare EMS responder teams for violence from patients on the job (Taylor & Murray, 2017), with the exception of a training intervention recently developed in the Netherlands to enhance paramedics' resources for dealing with violent bystanders (van Erp, Gevers, Rispens, & Demerouti, 2018). Practitioner articles within the EMS industry do provide potential organizational interventions that could mitigate the risks of assault. These include clear policies and procedures for police

backup, adjustments to the dispatch system to provide more contextual call information, flagging the system for previously violent households or persons, and as improving training to include cultural competency, de-escalation, and body language techniques (Nethercott, 1997). Other procedural changes include equipping EMS responders with additional personal protective equipment and creating clear departmental standard operating procedures (SOPs) and standard operating guidelines (SOGs) to improve reporting of assaults (Nethercott, 1997). Although these best practices have been discussed in industry journals, evidence-based organizational interventions for EMS is lacking due to the paucity of robust studies and evaluations conducted by the appropriate scientific disciplines.

Interventions that address policies and procedures at all levels within the fire department should acknowledge the MTS nature of the response to emergency calls. An MTS is made up of two or more interdependent component teams that interact directly to achieve shared organizational goals (Marks, Mathieu, DeChurch, Panzer, & Alonso, 2005), such as implementing evidence-based practice to improve EMS responder safety and providing quality patient care. These two shared organizational goals may present EMS responders with role-conflict (i.e., if responders should choose to sacrifice their personal safety for that of their patient's well-being). However, if an organization provides support and resources supported by policy and training, then it facilitates an EMS responder's ability to effectively carry out the parallel goal of patient care. We believe that an effective intervention targets policies and procedures across the MTS in a fire department including EMTs, paramedics, firefighters, leadership and union officials, as well as other entities such as dispatch and law enforcement.

Leveraging Group and Team Problem-Solving

Given the nature of the problem presented, it stands to reason that the science of groups and teams may be a resource for improving emergency responder safety (Williams, Rose, Simon, & Med Teams Consortium, 1999; Wilson, Burke, Priest, & Salas, 2005). Most of the research on emergency responder teams focuses on patient, rather than responder, safety (Patterson et al., 2016). In their call for more research and the use of teams in emergency medical response, Williams and colleagues (1999) focus on error reduction and improved performance with reference to patients alone. Wilson and colleagues (2005) further discuss how emergency medical response teams could be improved when key behavioral markers associated with high-reliability teams in other contexts (e.g., airplane crews, military patrol teams) are adopted in the medical service delivery. Again, the focus of these calls and

subsequent research has been primarily upon patient safety. To date, there is a paucity of systematic team research focused on improving emergency responder safety from the perspective of keeping the medical response team safe while delivering services to patients.

We propose leveraging good team problem-solving strategies using the hackathon method to help introduce solutions (Fiore, 2008). For this INGRoup hackathon, EMS responders with teams were paired with team dynamics researchers to uncover new strategies to mitigate, reduce, and eliminate (in some cases) violence against first responder teams. In doing so, hackathon teams considered both the organizational and environmental constraints, including the MTS in which responder teams are embedded. In some cases, this impacted their team's approach and final proposed solution. Our ultimate hope is that these teams or others will take up the call to investigate this problem further and use these ideas as a springboard toward reachable solutions.

Method

Sample and Procedure

The study presented here is a hackathon-style qualitative field study (Kopeć et al., 2018; Tracy, 2013). Thus, the event reported here deployed the hackathon method (Briscoe & Mulligan, 2014); the results are presented as descriptions of the solutions similar to other qualitative field studies (Tracy, 2013). The INGRoup 2018 Hackmanathon followed a detailed schedule for team interaction and solution development. Interested individuals and teams from the INGRoup membership were organized into three teams of four individuals. Individuals and teams were recruited via an announcement to INGRoup membership using the member listserv and website. Each individual or team submitted applications for participation and the INGRoup Conference Program Director assembled the teams to ensure an equal distribution of faculty and students. Members of the teams included psychologists, management scholars, communication scholars, and public health scholars. It was not possible to equally distribute the disciplines across the teams; however, all team members were self-proclaimed groups and team researchers, which provided a commonality across the disciplinary differences that could be leveraged toward the focal problem. No team was composed entirely of one discipline, thus some level of interdisciplinarity existed for all teams. Teams were encouraged to make the event a cooperative competition, to develop effective solutions for the benefit of everyone, and to consult each other across teams to help each other as needed. In addition, the following

rules were stated and shared openly: (a) teams may meet only during the designated work periods, (b) teams may consult (i.e., ask questions and receive guidance from) people only who are physically present for some part of the conference, and (c) final solutions must be delivered at the designated time.

Teams were assembled into teams of scientists and were encouraged to consider the other teams involved in the project as potential partners in their effort; specifically, cross-team talk was encouraged. Teams were given unrestricted Internet access via the conference center Internet services and all the description materials and resources, including literature cited, were referred to in the original hackathon call for applications. Thus, a good portion of the literature review needed to begin the process was completed and provided for the groups. In addition, each group was provided the opportunity to interact with SMEs attending the conference. Specifically, experts from the local area (i.e., firefighters, EMS personnel) who knew, experienced, and lived the problem day-in and day-out were invited to attend the conference and serve as a resource to the teams. Finally, teams were allowed and encouraged to consult (i.e., ask questions and receive advice from) any INGRoup conference attendees with relevant expertise or information.

Each team was tasked with delivering a presentation to the entire conference with 10 min to present the team's solution and 10 min for questions. This took place at the conclusion of the event and conference. Presentations were to include the team's response to the challenge question and a discussion of the solution for consideration by the audience. The all-conference audience was tasked with evaluating which team performed the best considering the following criteria: (a) quality of team's response to the challenge, (b) originality of team's response to the challenge, and (c) interdisciplinarity of team's response to the challenge. Each attendee indicated which team accomplished these criteria to the greatest degree. The votes were counted, and the winning team was announced. Specifically, the audience was asked to "indicate on the note card, which group's proposed solution was the best." Approximately 150 votes were cast during the session.

Results

The results presented are the potential solutions and ideas generated by the three interdisciplinary teams. Each team describes the problem or issues of focus for their solution. The solutions are then described in detail, ideally in a fashion adequate for a researcher or a practitioner to implement the solution. Each team then concludes by directing the effort forward. Thus,

each potential solution is presented here for further consideration and interpretation.

Proposed Solution From Team 1

Team 1 focused on creating a solution that addresses barriers to effective training of EMS responders on violence. Economic challenges and budget constraints were identified as one of the leading barriers contributing to the lack of training opportunities for fire-based EMS organizations. Trainings and simulations that require time away from day-to-day operations but are essential for safety are often one of the first expenditures to be cut by fire departments experiencing budgetary hardship (Nozzlehead, 2009). SMEs also noted that the majority of formal training received by the SMEs is delivered via self-directed, non-engaging, and non-kinesthetic briefs. SMEs described a lack of enjoyment in these traditional training methods and expressed that it was a waste of time that would be better spent responding to calls in the field.

In addition, the issue of stigma was raised by SMEs when describing violent encounters and asking for help (Edmondson, 2002; Rundmo & Hale, 2003), particularly from their police counterparts. Due to staffing shortages across public safety sectors, SMEs described some hesitation to reach out to police for backup, and similar hesitation by police to provide backup, often questioning the veracity of EMS requests. Without necessary resources or support for backup assistance, EMS responders often place the burden of their personal safety entirely on themselves or place patient safety above their own.

Therefore, Team 1 proposed the development and implementation of the Situational Awareness For Emergency Teams (SAFE-T) training program. The focus of the SAFE-T program is to increase both individual and shared situational awareness (SA; i.e., Powers, 2018) through effective risk assessment, conflict management and de-escalation, emotion regulation, and elimination of distractions to patient care.

Situational awareness. SA requires an advanced level of situational understanding as well as understanding future states of the system and how those might relate to current goals (Endsley, 2017). SA is considered a skill that can be trained at both individual and team levels (Endsley & Robertson, 2000; Salas, Prince, Baker, & Shrestha, 1995) and is known to be predictive of team performance outcomes (Salas, Stout, & Cannon-Bowers, 1994). Scholars have argued that SA has serious implications for safety outcomes in such complex systems (Stanton, Chambers, & Piggott, 2001). Research further

suggests that teams benefit from developing interwoven patterns of SA that include individual, intragroup, and intergroup shared understandings of a given situation (Sonnenwald & Pierce, 2000).

Training program. In recent decades, research has put forth evidence that supports the use of simulations for training individuals and teams (Ward, Williams, & Hancock, 2006), such as multidisciplinary teams in medical settings (Merién, Van de Ven, Mol, Houterman, & Oei, 2010). Simulations have been demonstrated as an effective strategy for acquiring knowledge as well as practicing and refining skills that transfer back to the working environment (Ward et al., 2006). Reviews on the use of simulations for training reiterate their effectiveness in terms of training transfer and highlight the four driving components as fidelity, immersion, presence, and operator buy-in (Alexander, Brunyé, Sidman, & Weil, 2005).

Team 1 proposed a tiered approach to developing strong SA skills through education and practice using high-fidelity simulations. The SAFE-T training goals were to: (a) identify and interpret cues reflective of potential and present threats to responder safety, (b) maximize environmental scanning and communicate critical situational information while avoiding unnecessary redundancy, (c) strengthen adaptive skills and techniques by responding to simulations of inaccurate and/or incomplete information and unexpected violence, and (d) develop and hone appropriate response techniques through repeated training opportunities.

Levels of training. The SAFE-T program incorporates four levels of training with increasing complexity and tiered learning objectives that scaffold on the previous units. This was developed with a focus on the core tenets of adult learning theory (Knowles, Holton, & Swanson, 1998) and instructional systems design (ISD; Aguinis & Kraiger, 2009; see Table 1). In particular, the SAFE-T program incorporates empowerment through self-directed learning and leveraging of past experiences and knowledge, guided by principles that support analyzing, designing, developing, implementing, and evaluating (ADDIE) formal training content. Team 1 recommends this approach to ensure relevance, fidelity, and transferability of knowledge and skills to the job (Aguinis & Kraiger, 2009).

Level 1 presents trainees with a number of scripted scenarios that provide instruction on how to identify and communicate critical cues of potential violence in a series of interactive video tutorials. In this process, trainees are actively prompted to identify cues of potential violence in their environment including patient conditions, potential weapons, disgruntled bystanders, presence of alcohol or drugs, and other environmental hazards.

Table 1. Levels of SAFE-T Training Program.

Level	Overview	Format	Learning objectives
1	Present trainees with scripted scenarios that identify critical cues	Video tutorial	• Identify cues of potential violence • Understand what to communicate to partner and when
2	Trainee teams navigate potentially violent scenarios in a high-fidelity virtual environment with active instructor feedback	Team simulation	• Identify cues in the environment and other non-player characters • Know where partner is • Understand de-escalation strategies
3	Trainee teams navigate potentially violent scenarios with varying degrees of difficulty and distractions	Team simulation	• Identify cues while filtering distractions and managing more complex task demands • Communicate critical information • Decide when situation is becoming violent • Understand how to best de-escalate or stage
4	Multiteam event that includes all responders coordinating together to secure a scene and keep each other safe	Multiteam simulation	• Identify what cues need to be communicated within and across teams to ensure safety of all responders • Practice managing de-escalation • Practice staging

Note. SAFE-T = Situational Awareness For Emergency Teams.

Taking a more interactive approach, Level 2 involves a high-fidelity team-based simulation where teams of two are tasked with navigating potentially violent scenes while receiving active feedback from an instructor throughout the simulation. The simulation and constant feedback allows trainees to begin identifying violence cues and learn what to look for in their environment. Furthermore, this iteration will aid responders in understanding where their partner is and how de-escalation strategies can attenuate the potential for violence.

Level 3 increases scenario complexity and removes active instructor feedback to stimulate self-directed learning. These scenarios range in degrees of difficulty (i.e., number and types of cues present) and include various degrees

of environmental distraction to enhance fidelity. Trainees are tasked with identifying and communicating cues of potential violence while filtering distractions and attending to more complex task demands. Through the execution of these training scenarios, Team 1 anticipates that EMS responders will develop a better understanding of how to decide when a situation has moved from potentially violent to violent and how to best de-escalate the situation or stage (i.e., wait on scene for backup to arrive).

Finally, Level 4 involves a more dynamic simulation including multiple teams coordinating in complex high-demand scenarios. This may include fire rescue, police, other EMS teams, and/or dispatch. In these scenarios, each team is assigned their own proximal goals (e.g., EMS responds to patient, police take statements from witnesses, etc.) and the shared superordinate goal of keeping all responders safe throughout the scenario. This level of training has the potential to aid in the development of cohesive teams-of-teams that can effectively communicate and coordinate under the demands of highly complex scenarios with multiple parties and unique team goals.

Sister stations. To ensure the feasibility of the SAFE-T training program, Team 1 also identified barriers to implementation through SME interviews. As many fire and rescue departments are understaffed and overburdened, on-duty availability to participate in training is scarce (Goode, 2015). In practice, even required trainings and recertification examinations are typically completed off duty during personal hours.

To address this issue, Team 1 developed a solution that involves enacting a system of sister stations. This system involves pairing a fire and rescue station that is of *high intensity* (i.e., high call frequency and high call severity) with a station that is of *low intensity* (i.e., low call frequency and low call severity). Teams of firefighters and EMS personnel would rotate between sister stations every 2 to 3 months. To facilitate effective training, personnel would rotate stations together, keeping teams of emergency responders intact (Salas et al., 2008).

In general, high-intensity stations experience higher levels of burnout due to higher workload, higher levels of stress, and being routinely exposed to traumatic events (Lourel, Abdellaoui, Chevaleyre, Paltrier, & Gana, 2008). General job-related chronic stress and post-traumatic stress disorder (PTSD) related acute stress have been shown to contribute to burnout in fire service personnel (Mitani, Fujita, Nakata, & Shirakawa, 2006). Additional research has demonstrated that health care workers experience lower burnout prevalence with the implementation of work hour limits (Martini, Arfken, & Balon, 2006). Therefore, it is expected that by enacting a system of sister stations, personnel assigned to high-intensity stations could transition to lower-intensity stations to

receive a "rest" period and ultimately reduce burnout. This period of increased downtime could also be used to provide increased training opportunities. The reverse benefits would be realized by low-intensity personnel.

Proposed Solution From Team 2

Team 2 directed their focus to workplace cultural issues that reinforce independence and discourage asking for help, as well as a lack of trust between EMS personnel and other emergency responders. Given the general lack of training given to address violence on the job as well as the need to enhance adaptation skills and experience unsafe situations in a safe, controlled environment, Team 2 proposed a training simulation entitled Risk Assessment Driving Adaptive Responses (RADAR). To ensure that RADAR is effective at addressing important issues such as violence and actionable in the real world, Team 2 focused their solution at the firehouse level, which SMEs considered to be the best place of implementation.

Training simulation. RADAR is a virtual reality (VR) training simulation that can be implemented in any firehouse, with few additional resources required. This type of simulation differs from a traditional VR simulation in that it also includes *autonomous agents*, which are virtual characters programmed into the simulation that can interact with and respond to the actions initiated by the real-world individuals who are participating in the simulation exercise (Hall et al., 2015; Johnson & Lester, 2018). For example, the autonomous agents can be programmed to react to EMS personnel turning away from them in the simulation, perhaps by becoming agitated and escalating an unsafe situation, which enables EMS personnel a more realistic preview of potential real-world behaviors, so they may develop and practice more appropriate responses that translate back to the job.

The RADAR training is designed to offer various situations and the capability to be utilized by both individual and team members. Individual EMS personnel may use the program to enhance SA, whereas pairs of EMS personnel may enhance trust and share knowledge of best practices, and combined EMS and fire personnel may enhance cohesion, trust, and adaptability. In particular, the training scenarios will include situations with patient risks (e.g., history of violence, dementia, and coming down from a high), environmental risks (e.g., violent areas, weapons on the scene, and low visibility), and bystander risks (e.g., crowded scenes, agitated bystanders, and people getting in the way). Moreover, RADAR training will offer the option to create new scenarios to address unique needs of a specific firehouse.

Team 2 anticipates that this high-fidelity training takes first responders through the steps of risk assessment, risk mitigation, and risk response to learn appropriate ways to respond to a variety of unsafe situations in a controlled context. RADAR enhances the necessary knowledge, skills, and abilities needed for effectiveness of both EMS and fire personnel in emergency situations. Logistically, RADAR training offers additional benefits. Data will be collected unobtrusively throughout the simulation to aid in after-action reviews (AAR) and provide feedback to enhance training for personnel. This training is low-cost in terms of both time and resources required, as the training can be done in any location, at any time, provided a VR headset is available. Finally, this training provides an avenue for overcoming cultural norms and building cohesive inter-team dynamics between EMS and fire personnel, which enables a more effective emergency response system.

Proposed Solution From Team 3

Team 3 developed a solution that requires EMS, fire, and police to identify, train, and develop as an effective MTS. Through interviews with SMEs, Team 3 identified multiple issues obstructing the creation of an effective MTS. According to the SMEs, the culture among EMS providers is one of toughness and independence. In a potentially dangerous situation, SMEs felt that EMS providers have been socialized to take on the situation themselves rather than call for the help of their colleagues from fire or police. A contributing factor to EMS's independent operationalization is the perceived lack of a shared identity between the three groups (EMS, fire, and police) that prevents them from working together in a coherent system and manifests in lessened trust and reliance as well as ineffective intergroup communication. Furthermore, there are currently limited evidence-based structures in place that allow EMS to share experiences with colleagues to find and offer social support (see Allen, Baran, & Scott, 2010 for an exception), which also prohibits them from building a knowledge repository to respond and cope with incidents of violence.

Team 3's recommendation falls within a broader approach in which they suggest that the three entities of EMS, fire, and police must acknowledge that they work in an MTS and build their organizations and interactions around the multiteam system framework.

Acknowledging the MTS. The primary recommendation proposed by Team 3 is to have EMS, fire, and police acknowledge that they are in an MTS (Luciano, DeChurch, & Mathieu, 2015). To develop the shared identity that is necessary for the overall success of an MTS, buy-in from top-level leaders is

critical (Davison, Hollenbeck, Barnes, Sleesman, & Ilgen, 2012). Team 3 suggests that leaders in EMS should be very explicit that first responder safety takes the highest priority and that only thereafter can they be of service to others in the community. This norm could be promoted explicitly in the mission statement of the EMS organization to motivate individuals to implement safety knowledge through a desire to be aligned with the organizational goals (Smith-Crowe, Burke, & Landis, 2003).

In addition, Team 3 recommends the implementation of a hero-narrative in both fire and EMS training that supports the norm of asking for and accepting help between fire and EMS providers, purporting these types of behaviors as "best" practices (Cunliffe & Coupland, 2012). Specifically, leaders and other respected members of the community should be encouraged to share stories of how they escaped from dangerous situations, where self-defense and prioritizing safety are commended as the best course of action. These hero narratives should become a routine part of EMS training and communications. Given that a primary motivation for becoming a first responder is to serve others, Team 3 suggests that organizations capitalize on that motivation by turning it inward, encouraging each group to protect each other. By communicating the norm of "provider safety comes first" throughout the fire and EMS groups, Team 3 believes a stronger sense of shared system identity and belongingness will subsequently stimulate safety practices that may significantly contribute to reducing violence incidents.

Building the MTS. Team 3 recommends the development of routines for anticipating, recognizing, and responding to violence and aggression as a coordinating system. A standard protocol for safety scenarios should be developed that gives medics the right to leave the scene or seek refuge in the ambulance when a situation is unsafe. Standardized scripts that outline the appropriate sequencing of events, guide planning, and execution of actions have been shown to be effective in reducing accidents in a military sample, especially where there are competing goals (Zohar & Luria, 2004). A positive, strategically focused safety climate motivates individuals to show appropriate safety behavior that is consistent with the organization's norms (Smith-Crowe et al., 2003).

Research on team training has shown benefits of training as a team in team processes and team performance (Delise, Allen Gorman, Brooks, Rentsch, & Steele-Johnson, 2010; Hughes et al., 2016), also for dealing specifically with instances of violence and aggression (van Erp et al., 2018). Team 3 therefore recommends the implementation of team training. Training items would include how to quickly recognize precursors to violence, therefore heightening team sensitivity and responsiveness to escalating situations. Training would also incorporate specific role-play scenarios for taking precautions

against risks of night work, vehicle theft of the ambulance, attempts to steal medical supplies or drugs, and dealing with aggressive pets in homes while responding to calls. Other role-play scenarios may involve practicing skills for approaching frustrated or agitated patients, family members, and other bystanders who may hinder the care process. van Erp and colleagues (2018) show that participating in such role-play exercises significantly increased paramedics' confidence and skills for dealing with violence and aggression while preserving employees' well-being and job dedication.

Team 3 recommends training EMS with fire and police so that all parties receive hands-on experience in dealing with incidents of violence and aggression together. Playing out these scenarios collaboratively would allow team members to practice specific interaction patterns in de-escalating and defusing violent situations and specify each component team's roles. Training collectively would also contribute to building a shared identity, trust relationships, and shared norms between members of the different component teams. This understanding may result in relevant safety information being shared more easily between agencies. For example, if one agency has flagged a home for violent behaviors in the past, the other first responder teams should be notified before arriving on scene.

Team 3 suggests building on successful shared identity experiences through AAR and online chat groups (Allen, Reiter-Palmon, Crowe, & Scott, 2018; Tannenbaum & Cerasoli, 2013). AAR refer to a debrief meeting in which first responders reflect on a particular incident and share insights with other responders about what happened, why a particular scene developed the way it did, what were crucial events or actions, and what one could have been done differently (Allen et al., 2010). The online chat group is a type of outlet that allows EMS responders to share experiences and find and offer support to one another in a less formal setting. This makes it possible to reach EMS responders who may otherwise be isolated in the organization and lack sufficient support from their surroundings. Both feedback channels offer first responder teams the opportunity to learn about how EMS can deal with violent incidents. This will not only support individual coping and learning but also creates a knowledge base that will support learning at the organizational level. This type of intermittent feedback can reinforce safety behavior, transform safety practice into a habit, make safety a priority over other performance targets such as speed, and address a variety of common and uncommon safety situations (Zohar, 2002). Moreover, it is vital to create an environment that is psychologically safe for sharing personal experiences. Discussions with SMEs suggested that to improve psychological safety, the online chat groups should therefore not include leaders but instead have elected "mentors" within the group that are seen as approachable. Furthermore, the chat

group must be exempt from legal ramifications or punitive actions by the organization and used purely for developmental and not evaluative purposes (Murphy & Cleveland, 1991, 1995).

Discussion

As demonstrated by the individual potential solutions from the teams, great thought and care were taken and important expertise was brought to the problem at hand. Perhaps, the obvious question and the one the lead authors in collaboration with the SMEs take up here is, "Will these proposed ideas work in practice?" We believe the answer is mostly "yes" and we discuss here why we feel confident, doing so for each potential solution in turn.

First, Team 1's idea of *sister stations* is already being discussed in the fire service. Because of the high levels of burnout EMS responders are experiencing on the job, it has been discussed that busy medics should be detailed to less busy stations for a small rest period from the daily demands of their job at a busy firehouse. Team 1 builds upon this idea by suggesting the rotation of teams together rather than separating individual members from the team that they know. As this is consistent with groups and teams research concerning camaraderie and cohesion (Joo, Song, Lim, & Yoon, 2012; Patterson et al., 2016), this is an important addition to the sister station idea which, while being practiced in the fire service to a very rare extent, has not yet been evaluated for its impact.

Team 2's simulation solution that uses artificial intelligence (AI) infused VR platforms is creative and innovative. As gaming and virtual video platforms are already used for disseminating information in the fire service, it would be considered a highly acceptable implementation. The adoption rate of such an endeavor would be quite high. Our major concern, and one shared by the SMEs, is the feasibility of the development of such a platform. Although dissemination of the virtual-reality trainings should be relatively low cost, development of the platform may prove quite costly and require support from outside the fire service prior to launch within the service. One recommendation for this particular solution is the consideration of partners in the community that could support the platform development and then networking the dissemination thereafter. It should be noted that this approach has worked in the past, as demonstrated by the Federal Emergency Management Administration's (FEMA) various grant programs (e.g., Assistance to Firefighters Grants [AFG], Research and Development [R&D], and Fire Protection and Safety [FP&S]).

Team 3's MTS intervention is also appealing because of data that exist elsewhere in the fire service about divergent perceptions between leadership

and the rank-and-file. The idea of paired leader–follower discussions to improve safety communication is very plausible. Furthermore, the idea of adding provider safety as a priority within the organization's mission statement is something already being considered in an organizational-level checklist being developed for EMS responders and the fire service (Taylor et al., 2019). Furthermore, Team 3's idea of having a standardized checklist to ensure EMS responders safety is in line with SOPs and guidelines are commonly used in the fire service. That said, the feasibility beyond that is difficult to determine, as Team 3 did not have the time to thoroughly specify what these might look like and how they would be deployed. However, such checklists would be immediately useful and likely adopted by the fire service because safety climate trainings are currently running across the country, and fire department leadership is asking for interventions to improve safety.

In addition to team-specific reactions and thoughts from the SMEs, there were several observations worth mentioning across the teams. First, the SMEs and partners involved with current fire service interventions wanted it to be known that the teams should be congratulated on their comprehension of important priorities in the fire service after only 2 days of introduction. In addition, it is interesting that two of the three teams looked to simulation as a solution and that all three teams recognized the importance of training in a collaborative and protected environment.

Second, it was noted that two of the three teams focused on developing an MTS intervention with an emphasis on communication. Commendable though this is, only Team 1 mentioned the potential utility of including dispatch in their intervention and the potential communication challenges that may arise. If pursued and eventually deployed as interventions, additional work is needed to incorporate dispatch into the MTS framework seemingly espoused by the groups (Mathieu, Marks, & Zaccaro, 2001). Furthermore, none of the interventions proposing the use of the MTS framework mentioned the issues of biases that may exist between groups. For example, there may be an in-group versus out-group bias between different teams in the MTS (Perrott & Taylor, 1994). Firefighters and police officers, in some cases, view incident responding and processes differently, creating conflict that may heighten this form of bias.

Third, related to the MTS framework, the interventions seem to gloss over some of the key characteristics of MTSs and challenges that they present (Marks et al., 2005). For a review of MTS literature and an introduction to MTS in general, see Zaccaro, Marks, and DeChurch (2012). In terms of EMTs and emergency responders, several questions need to be considered before, during, and throughout any intervention for the purposes described here. For example, is there an understood hierarchy among teams in the

MTS? Does the nature of the MTS change when police versus others are authorized to use force? Which team arrives first (or last) to the scene, and what issues does that present? As the teams hand off responsibility from one team to another, what processes need to occur? These and many other questions need to be considered with any intervention that would also have the espoused consequence of improving EMT safety.

Finally, while these interventions are supported in concept by discussions already beginning to formulate in the fire and rescue service, there holds great benefit in bringing the fire and rescue personnel to the hackathon procedures and proposed solutions. SMEs and partners both acknowledged that additional member-checking by those in the occupation will allow greater acceptability and utility of interventions. Involving key stakeholders at every step of the design and implementation phases ensures that the solutions have the best potential to make a difference. Leadership and union buy-in will be crucial to the success of interventions like those described here; therefore, it is imperative that any interventions speak to the priorities and needs of the fire and rescue service.

General Reflection on the Hackathon and Conclusion

To our knowledge, this is the only competition that brings together a multidisciplinary group of team researchers and practitioners to solve a high-impact, real-life problem. Two major potential opportunities arise from this joining of science and practice. First, the hackathon offers social scientists who often work within their respective silos the opportunity to interact across disciplines on a goal-directed effort to solve a real-world problem with the social science of groups and teams (Kuligowski, 2017). Essentially, the hackathon approach engages the science of team science to help with a team problem (Tebes & Thai, 2018). Second, the hackathon offers scientists get the chance to interact with, learn from, and partner with experts in their craft, their practice, and their environment (Allen & Reiter-Palmon, 2019). Too often valuable research is conducted unbeknownst to the practitioners who have the power to implement lessons learned. The hackathon as implemented at INGRoup becomes a community-engaged scholarship opportunity (Allen & Reiter-Palmon, 2019), particularly in the current example where the SMEs are servants of the community and are there to enhance and safeguard community well-being, one emergency call at a time. Challenges such as these are a unique opportunity to bridge the gap between academics and practitioners in a meaningful way.

That said, the hackathon is not without challenges that will need attention in the future. The activity was designed as a *team* activity within a *team-based*

competition. Teams for the hackathon internalized their own team identities and created strong between-team boundaries, which created team competition as opposed to team collaboration. To encourage cooperation and enhance impact created by teams in future *hackathons* (or similar), perhaps the activity should be modeled on best practices from MTS literature (DeShon, Kozlowski, Schmidt, Milner, & Wiechmann, 2004; Luciano et al., 2015). There are many best practices for MTS functioning, but we believe a few are particularly important for the INGRoup Hackmanathon moving forward. First, ensuring the teams have one shared, superordinate goal across the teams is essential. The current process for the hackathon attempts to establish this with the use of a detailed problem description and an application process that requires participants to express an interest in solving the problem outlined. However, during the event, additional reminders and efforts should be made to deter goal drift and competition that may supersede problem-solving. Second, future hackathons should help to foster team-level goals that feed into the superordinate goal and do not compete with one another. Hackathons are competitive by nature, which in turn motivates participants. Additional consideration and strategizing are needed to retain the motivation without the negative behaviors that sometimes accompany competition between teams/groups (Perrott & Taylor, 1994). Third, following MTS best practices, teams should share resources and ideas across boundaries. During the hackathon described in this article, resources (e.g., amount of time with SMEs and Internet access) were shared. However, we do not believe ideas were shared across team boundaries but were kept secret until the all-conference presentation. A caveat to this more collaborative approach is that greater idea sharing may hamper the development of unique and meaningful potential solutions. As a one-size-fits-all approach to problem-solving is not always desirable, the competition and with-holding of resources or information may foster and force novel solutions. Thus, an appropriate competitive and cooperative balance is likely the ideal. Fourth, feedback should be provided at early stages to help each team attain its goals and mitigate duplication of effort. Conceptual overlaps in the described team solutions may have benefited from more collaborative feedback throughout the process.

One important idea for future hackathons may be to include a post conference session for the teams and encourage them to collaboratively consider their ideas. Although one may have been identified as a winner, the ideas may have similarities, differences, and opportunities from which a more potent solution could emerge. Actionable solutions, which are the very thing that a hackathon boasts of generating, may be enhanced with adequate post-hackathon processing. Perhaps, this unique addition could lead to a comprehensive multifaceted solution for the *wicked* problem (Cleland, Patterson, & Hanson, 2018) of, in this case, violence against first responders.

In conclusion, it is generally acknowledged that the INGRoup Hackmanathon can be improved. It incorporates competition while ascribing cooperation and achievement of shared goals. As many team members noted, the hackathon directly overlaps with a conference they want to attend. This may be an inevitability, as there may be no other time where these interdisciplinary team scholars are able to gather in this way. Furthermore, the authors and INGRoup leadership continue to look for ways to improve the hackathon, considering everything from the rules to the format, timing, and design. We seek continuous improvement while also acknowledging how remarkable it is to see such potential solutions being generated in an extremely short time span. In 2 days, the teams performed a remarkable feat. We hope that being transparent with the process and outcomes here will spur both the refining/implementation of the solutions and the continued effort to bolster this and similar activities even as we seek to improve them.

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