FIRST RESPONDERS' CRISIS: HOW AI CAN HELP TO BRING MORE INTERNAL WORKFORCE FOR EMERGENCIES AND SEASONAL WORK FASTER AND AT LOWER COST

Tetiana Sydoruk[1]

[1]Masters of Public Administration in Government, Pace University, Masters of Business Administration in Project Management and Accounting, DeVry University, Keller School of Management, Medical Tech Systems US, e-mail: Tetiana.sydoruk.m@gmail.com, ORCID: https://orcid.org/0009-0002-4097-7177

Abstract. This article focuses on analyzing crisis situations in emergency response services and the role of artificial intelligence in enhancing their efficiency. The study aims to examine the challenges faced by emergency services and determine how artificial intelligence can help mobilize more internal resources for responding to emergencies and seasonal work. Methodology and methods: the study employed general scientific methods of cognition, such as analysis, synthesis, modeling, and forecasting. The research results indicate that natural and man-made disasters, such as floods, accidents, and terrorist acts, lead to loss of life, suffering, and infrastructure destruction. The main causes of challenges include a wide range of conditions such as weakness, unspecified injuries, changes in mental state, acute pain, general abdominal pain, and other less defined conditions requiring medical assistance. The increase in calls for psychological help points to an escalation of mental health issues among the population. During seasonal changes, there is a rise in the number of calls. In winter, due to harsh weather conditions, dangerous situations related to snowstorms and avalanches occur more frequently. Artificial intelligence can significantly improve the efficiency of emergency response services by allowing for more productive use of available resources. Utilizing specialized mobile applications, chatbots, volunteer training, and AI-powered drones can enhance coordination, resource allocation, and response speed to emergencies. Additionally, AI-based technologies such as predictive systems and route optimization can help overcome geographical challenges. The practical significance of the study lies in identifying ways to enhance the efficiency of emergency response services through modern technologies.

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Introduction. In the modern world, rapid response services are facing unprecedented challenges that span a broad spectrum of situations, from natural disasters to technological accidents and terrorist attacks. These events not only result in significant human and material losses but also test the limits of emergency services' capabilities and resources, often revealing gaps in their preparedness and response. The urgency of optimizing the operations of these services has never been greater, and the need to implement innovative technologies, particularly artificial intelligence (AI), to enhance the efficiency and adaptability of emergency responses is becoming increasingly evident.

The issues to be addressed encompass not only the shortage of personnel or limited physical resources but also the ability to quickly and effectively analyze large volumes of information, make informed decisions, and adapt to dynamically changing conditions. In this context, AI can play a crucial role by offering solutions for automating routine tasks, optimizing resource distribution, improving communication, and coordination among various services, and training personnel through simulations of real-life emergency situations.

Literature review. The issue of artificial intelligence's impact on increasing internal personnel for emergency response and seasonal work more efficiently and at a lower cost is underexplored in the scientific literature. This issue was examined by breaking it down into smaller tasks, which allowed for identifying the characteristics of emergency response workers, identifying problems, and determining how they can be addressed using artificial intelligence. Significant contributions to the development of this topic have been made by authors such as Asay (2023), who studies the impact of artificial intelligence on cost savings, productivity, and employment, which can help reduce labor costs in emergency services. Additionally, Baetzner et al. (2022) made substantial contributions by evaluating the effectiveness of training programs for emergency medical workers in their literature review, which is critically important for crisis preparedness.

Doke, Affinnih, & Yuan (2021) focused on improving emergency preparedness and response in rural areas, emphasizing the importance of technology for coordination and resource management under limited capabilities. George and Sweeney (2022) analyze state actions to address workforce shortages in emergency medical services, highlighting the importance of public policy in solving labor issues in this critical field. Germann (2023) examines ways to use artificial intelligence to reduce labor costs in business, which can also be applied to emergency services.

The research also utilized expert literature, including publications in modern online editions that cover current aspects of the topic. For instance, Mandhani (2023) on LinkedIn explores how artificial intelligence can assist the workforce, while Peyton (2023) in a blog on Common Ground analyzes the challenges faced by emergency responders.

Aims. The aim of the article is to identify solutions for how artificial intelligence can address the emergency aid crisis by reducing costs and accelerating the search for personnel to manage service workloads and disaster-induced demands.

The main objective of the article are:
− to identify the primary sources of the emergency response workforce crisis;

– to highlight the main types of problems faced by emergency responders;
– to determine how artificial intelligence can help solve these problems;
– to assess the impact of artificial intelligence on the speed of recruiting additional emergency response personnel.

Methodology. The study employed general scientific methods of cognition, such as analysis, synthesis, modeling, and forecasting.

Results. Natural and technological disasters, such as floods, accidents, and terrorist attacks, occur worldwide, leading to loss of life, human suffering, and infrastructure destruction. These events create particularly complex situations for emergency services as they are unpredictable and usually occur suddenly, overwhelming local capabilities and resources for rescue and aid provision (Baetzner et al., 2022). Beyond disasters, everyday life also presents high demands on rapid response services in the US, leading to overburdening. Over the years, there has been a steady increase in the number of calls, further stressing the emergency system and its resources. The main reasons for these calls cover a wide range of conditions, including various symptoms and diseases such as weakness, non-specific injuries, mental state changes, acute pains not classified elsewhere, general abdominal pains, and other less defined conditions leading to medical assistance requests (NEMSIS, 2021).

There's also a noticeable increase in calls for psychological aid, occurring against the backdrop of rising mental health issues, tragic incidents involving law enforcement, and increased reports of psychiatric admissions in emergency departments. This indicates an escalation of mental health problems among the population, leading to more calls to emergency hotlines and other psychological support services (Saunders et al., 2023). It's worth noting that only 28% of calls are classified as truly emergency, requiring immediate response. This suggests that a significant portion of emergency services' resources is spent on handling non-emergency cases, potentially leading to delays and reduced effectiveness in responding to genuinely critical situations, endangering the health and lives of patients needing urgent aid (NEMSIS, 2021).

Most of the issues listed have a seasonal nature. In winter, for example, emergency service workers often face hazards related to severe weather conditions, such as snowstorms and avalanches, especially in the country's mountainous areas. These conditions can lead to a significant increase in traffic accidents, hypothermia, and other weather-related injuries, requiring quick and effective intervention by rescue services. Summer brings another set of challenges, including fires, hurricanes, and floods, especially in coastal regions and the southeast. These natural phenomena lead to long-term consequences, such as community life disruptions, spread of waterborne diseases, and environmental pollution. During spring, there's an increase in cases of depressive exacerbations and other mental disorders among the population, necessitating the involvement of mental health professionals to provide assistance.

Seasonal factors significantly affect the operation of rapid response services, with some periods characterized by an especially high level of challenges, potentially leading to system overload. This overload is often observed during natural disasters or epidemics. During the COVID-19 conditions in 2020-2021, this issue became particularly relevant as global healthcare systems faced unprecedented demands. The need for medical personnel, equipment, hospital beds, and population vaccination

surged, significantly exceeding available resources. As a result, contemporary rapid response services face a range of challenges that threaten their ability to effectively perform their vital functions (Fig.1).

Among the biggest challenges they face is the high volume of calls, which continues to grow each year, causing system overload and delays in emergency response services. This problem is exacerbated by a staffing crisis, as a lack of qualified professionals limits the ability to respond quickly and provide quality assistance. The geographical crisis is also a significant challenge, especially in rural and remote areas, where large distances and challenging natural conditions complicate rapid assistance provision. The technology equipment crisis further deepens these issues, as outdated or inefficient equipment and methods do not fully leverage the potential of modern technologies to improve emergency response (The White House, 2022).
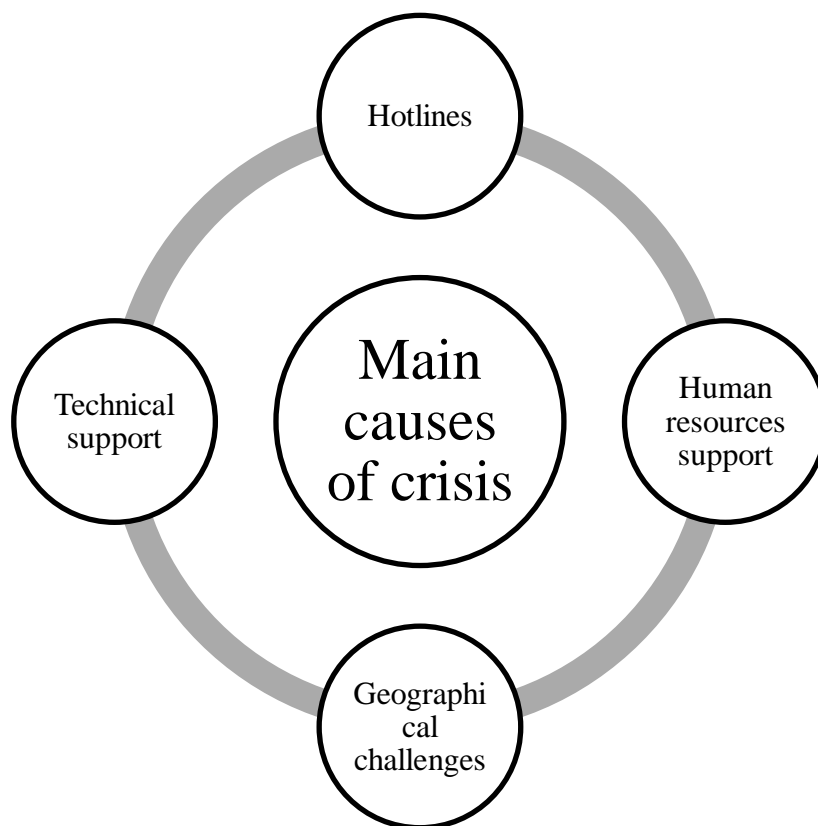

Figure. 1. Main causes of crisis in rapid response services
Sources: developed by the author

Crisis hotline challenges. Crisis hotlines, similar to "911" for situations related to suicidal thoughts, mental health crises, and substance abuse, play a critical role. They connect individuals in crisis with qualified crisis counselors who can provide immediate assistance, assess risks, and refer to appropriate support services. Thanks to the national "Lifeline" network, which includes over 200 local crisis centers accessible through the three-digit number 988, and numerous independent hotlines, help has become more widely available. However, despite these resources, the system faces challenges related to the volume and complexity of requests, insufficient funding and resources, and a shortage of qualified professionals, especially during peak periods. This can lead to delays in assistance, reduced service quality, and the loss of

opportunities to provide timely help to those in most need (Saunders et al., 2023).

Staffing crisis. The shortage of personnel in the U.S. rapid response services, extending beyond the medical field to include fire departments, rescue services, and other emergency services, presents a significant challenge. This issue has several facets:

–resource scarcity: many areas often face limited resources necessary for the effective operation of rapid response services, including equipment, technology, and training materials. This can restrict opportunities for training new specialists and upgrading the skills of existing personnel (The White House, 2022).

–high stress and burnout: rapid response service workers are constantly faced with extreme situations and the need to make critical decisions quickly. This can lead to professional burnout, decreased motivation, and, consequently, a reduction in the number of qualified workers (Peyton, 2023).

–need for call prioritization: in the context of staffing shortages, rapid response services may need to prioritize calls, which can lead to delays in responding to less critical cases that still require immediate intervention (Saunders et al., 2023).

–financial and legislative initiatives: some states and counties are implementing financial incentives and legislative changes aimed at attracting and retaining specialists in the rapid response field. This may include changes in licensing requirements, increased wages, support programs, and insurance (George & Sweeney, 2023).

Geographical Crisis. The geographical features of rural areas in the U.S. present a unique set of challenges for rapid response services, particularly in emergency situations. Let's explore these issues and their implications in more detail:

–large distances: rural areas often feature scattered settlements and extensive territories covered by rapid response services. This increases the time required to reach the scene, especially in emergencies where every second counts. This can complicate the provision of urgent assistance and increase the risk of adverse outcomes for the victims.

–transportation barriers: the presence of limited transportation routes, such as single-lane roads or narrow bridges, can pose a serious barrier to effective emergency response. This also complicates the evacuation of populations when necessary, especially if the only available road is blocked or damaged.

–geographical obstacles: natural features such as mountains, rivers, and large forested areas can complicate access to remote locations where emergencies may occur. This not only increases the time to reach the scene but can also limit the types of vehicles that can be used for response and evacuation.

–weather conditions: rural areas are often more vulnerable to extreme weather conditions, such as snowfalls, downpours, or tornadoes, which can quickly turn existing geographical barriers into insurmountable obstacles, further complicating emergency response.

–limited infrastructure: the lack of developed infrastructure, such as airports, heliports, or specialized medical centers, can complicate the logistics of providing assistance and evacuation, especially in critical situations (Doke et al., 2021).

Technological Crisis. The technological crisis in the provision of emergency services in the U.S. poses a significant challenge to the efficiency of rapid response

services. One of the main issues is technological gaps in integration systems that hinder seamless interaction between various services such as the police, fire department, medical services, and other emergency services. This lack of integration can lead to delays in communications, incorrect routing of information, or the loss of critically important data during transmission between different agencies and departments (Powers, 2023).

Another aspect is the inadequate level of personnel training to work with the latest technologies, which can hinder the effective use of available technological solutions. All this points to the need for a comprehensive approach to modernizing technological infrastructure and processes in the field of emergency services, including investments in equipment upgrades, development and implementation of compatible systems, standardization of data exchange protocols, and ensuring regular staff training. Technological gaps in integration complicate the effective operation of rapid response services (Powers, 2023).

AI can significantly address the challenges faced by rapid response services. The key lies not in using AI to perform the same volume of work with fewer people but in enabling the same workforce to operate much more effectively. Although specific statistics on AI usage in rapid response services are not readily available, the National Bureau of Economic Research (2023) found that customer service agents using AI were 14% more productive than those who did not use AI tools, as they could resolve more support issues. This suggests that efficiency in the call processing sector of rapid response services can also be enhanced through AI (Asay, 2023). Let's explore how various AI technologies integrated into different technological solutions can enable faster and more cost-effective mobilization of a larger internal workforce for emergencies and seasonal work.
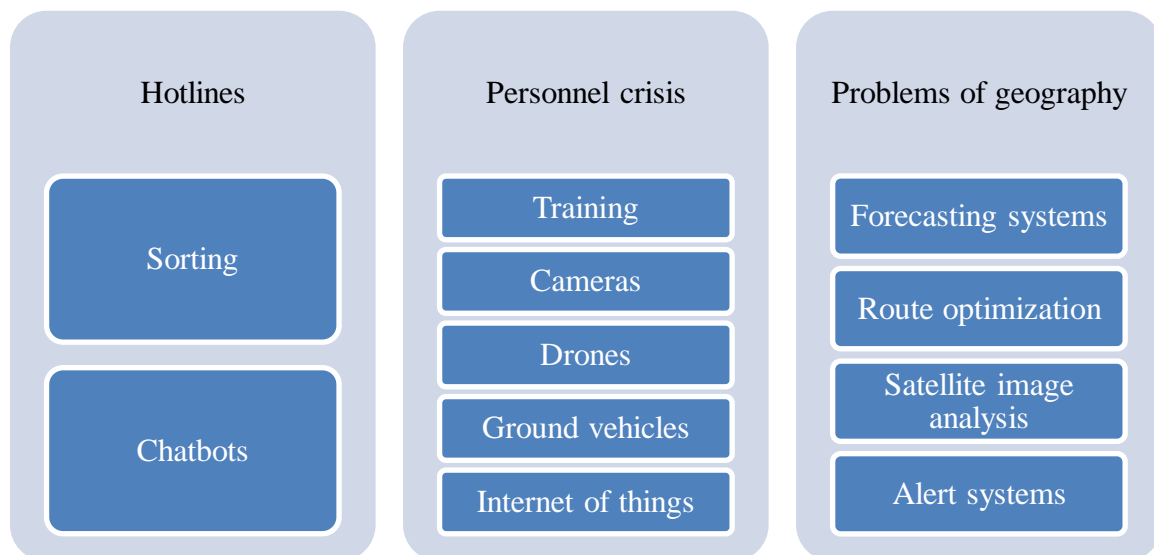
Hotlines	Personnel crisis	Problems of geography
Sorting	Training	Forecasting systems
	Cameras	Route optimization
	Drones	Satellite image analysis
Chatbots	Ground vehicles	Alert systems
	Internet of things	

Figure 2. AI solutions for rapid response services issues

Sources: developed by the author

The impact of artificial intelligence on the speed of engaging a larger number of emergency service workers is considered in Table 1.

Table 1. The impact of artificial intelligence on the speed and engagement of a larger number of internal workforces for emergencies and seasonal work

Technology	Impact on Rapid Response Services
Specialized Mobile Apps and Platforms	Enhances coordination and resource allocation, engages non-specialist staff for information sorting.
Chatbots	Automates responses to inquiries, eases the burden on operators, and engages additional personnel during peak periods.
Volunteer Training	Effective online training using VR/MR and AI to adapt and improve the training process.
Drones and Autonomous Flying Devices	Quick surveying of incident sites, delivery of medical supplies, and increased response efficiency.
Unmanned Ground Vehicles	Autonomous delivery of equipment and conducting rescue operations in hazardous conditions.
Internet of Things (IoT)	Monitors conditions and provides rapid responses to changes, collects data to optimize service operations.

Sources: developed by the author

Considering the high cost of developing and implementing such technologies, government funding plays a crucial role in making innovative solutions accessible to a wide range of rapid response services. Government funding programs are key in this process, providing the necessary resources for the development and implementation of innovative medical projects. These programs can include grants for scientific research, subsidies for infrastructure development, and special funds to encourage partnerships between government institutions, the private sector, and academic circles. An important aspect is also the creation of a regulatory framework that would facilitate the integration of cutting-edge technologies into emergency services systems while guaranteeing high standards of safety and confidentiality. Beyond direct funding, government programs can support the development of innovative projects by creating incubators and tech parks where startups and research institutes could work on developing new solutions for rapid response services. This approach not only stimulates innovation but also promotes the rapid implementation of successfully realized projects into practice.

Discussion. Many researchers see the utility of artificial intelligence in various aspects of addressing the challenges of engaging emergency responders. Mandhani (2023) notes that AI can help automate technology sorting processes. The use of specialized mobile applications and platforms for coordinating emergency services enables quick sorting of information about emergencies, resource allocation, and coordination between different agencies. This task does not necessarily need to be performed by medical professionals or rescuers; individuals with sufficient computer literacy and communication skills can handle it.

Germann (2023) highlights that AI can analyze large volumes of data and recognize patterns, providing valuable insights for businesses. Data-driven decision-making helps companies make informed choices based on current information and predictive analytics. Chatbots can be fully automated based on AI or "semi-automated," where an emergency response specialist selects the most relevant response from a set of options. This automation also allows for the engagement of more unskilled

personnel when needed for seasonal workloads.

Baetzner et al. (2022) emphasize the importance of online and computer-based training for volunteers and emergency response specialists, using modern computer technologies, including AI. This enables the creation of realistic simulations of emergencies that replicate the complex conditions professionals must operate in. The use of virtual reality (VR) and mixed reality (MR) in training programs allows for the modeling of various scenarios, from natural disasters to man-made accidents. These technologies are especially effective for training in resource allocation, providing medical assistance in disaster conditions, and practicing teamwork and quick adaptation to changing circumstances. AI helps tailor the training process to the specific needs and skill levels of each participant. Additionally, AI algorithms can analyze exercise results, identify weak spots, and automatically adjust the training plan to maximize efficiency.

Regarding unmanned vehicles, Powers (2023) emphasizes the use of drones and AI-powered autonomous aerial vehicles for rapid site inspection, delivery of medical supplies or equipment to hard-to-reach areas, and providing communication in places where traditional means are unavailable. These devices can be operated by specialists who are not rescuers but can manage the equipment and transmit organized information to the appropriate authorities.

Asay (2023) notes that the development of autonomous transport technologies can contribute to effective emergency response, allowing unmanned vehicles to deliver necessary equipment or even conduct rescue operations in conditions hazardous for humans. The integration of smart devices and sensors into the Internet of Things (IoT) system allows for real-time monitoring of environmental conditions, health, and safety of personnel, and quick response to changing situations. Examples of such devices include bracelets that read patients' individual medical indicators and surveillance cameras that can be installed in crowded areas or places with a heightened risk of emergencies.

Thus, involving artificial intelligence in solving the issues of engaging emergency responders includes technology sorting, using chatbots, training volunteers and trainees, employing drones and autonomous vehicles, and integrating IoT technologies. These approaches not only enhance the efficiency of emergency services but also allow for the involvement of more unskilled personnel, ensuring a rapid and quality response to emergencies.

Conclusions. AI and related technologies have the potential to fundamentally transform the operation of rapid response services, providing a higher level of efficiency and adaptability in responding to emergencies. This is made possible by the rapid sorting and analysis of information, automation of routine tasks, and engagement of additional personnel for specific tasks that do not require a high level of specialization. Online training using AI facilitates the training of volunteers and specialists, allowing them to acquire necessary skills in a safe virtual environment closely resembling real-life conditions. This not only ensures high-quality personnel training but also allows for rapid scaling of the training process to meet the needs for additional personnel during seasonal peaks or emergencies. Ultimately, the application of artificial intelligence and associated technologies not only enhances the efficiency

and responsiveness of rapid response services but also provides greater system flexibility and adaptability, enabling effective responses to the changing conditions and challenges of the modern world. Effective implementation of artificial intelligence in rapid response services requires significant funding and support for the development of specialized AI products to optimize emergency aid.

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